THE MAPLIN MAGAZINE

ELECTRONICS and Beyond

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December 1996 No. 108

Britain's favourite monthly magazine for electronics

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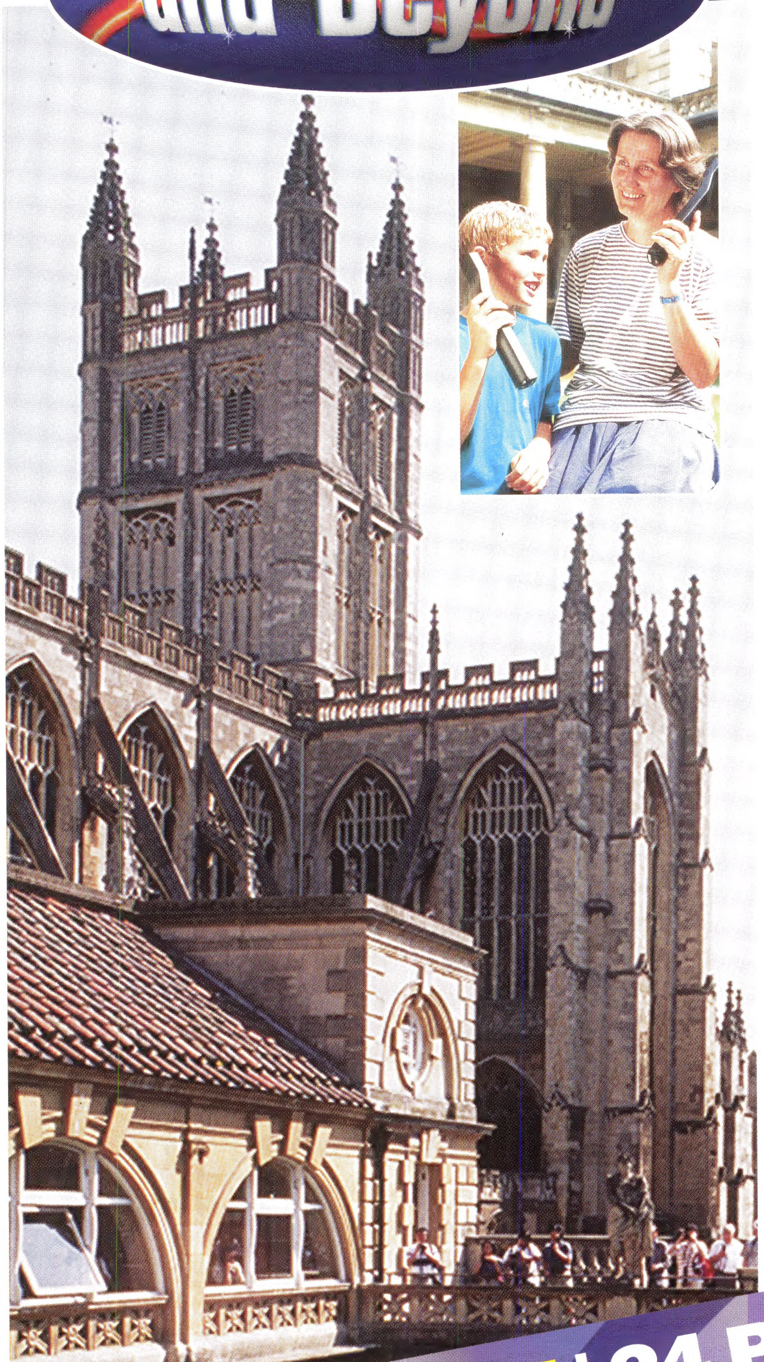
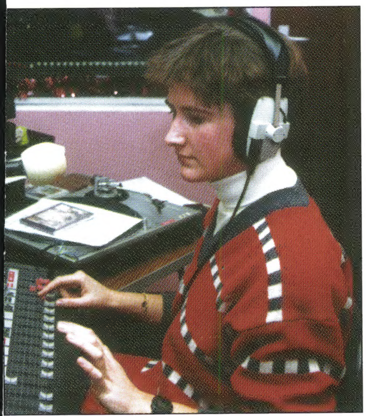
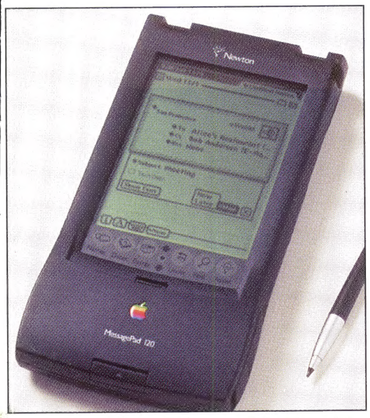




Community Radio

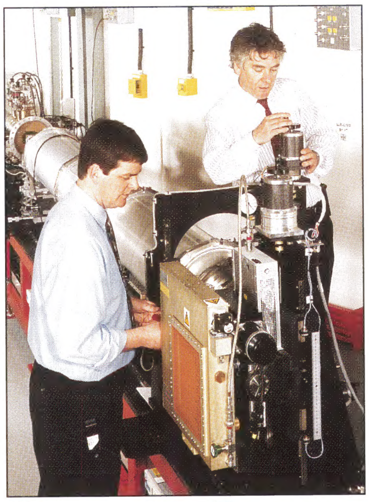
A Christmas Cracker



Apple's PDA

– A review

The Ring of Dazzling Light



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A UHF modulator designed to allow a host of video equipment items with composite video/audio output signals to be made compatible with a domestic TV set tuner.

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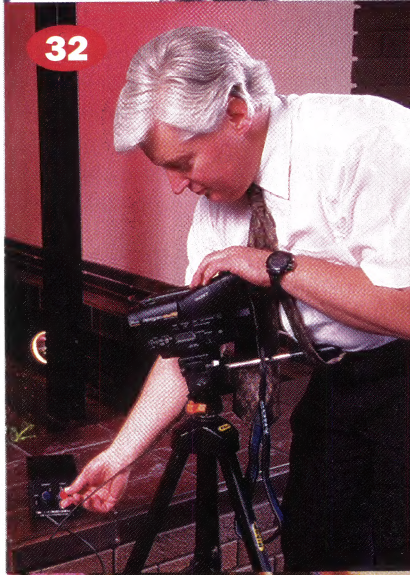

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Inside

Free pull-out Educational Supplement

Contains details of experimental projects to build.

See centre pages

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and Beyond

Hello and Welcome to this month's issue of *Electronics and Beyond*! You will see that we have enclosed a 24 page editorial supplement in this issue. This will be the first of many that will contain articles for schools. We welcome any feedback from Technology Heads and pupils for possible inclusion.

This issue also includes a £2 money off voucher to save on purchases of £40 or over from Maplin Stores or on orders from mail order. Alternatively you can save it, together with last months £5 voucher and receive a free gift when you take out a subscription to *Electronics and Beyond* (see page 5). Please note that this offer only applies to readers in the UK, and we cannot accept photocopies.

Stop Press

The Maplin Luton Catalogue Store is now open in the Arndale Shopping Centre, making it easier for enthusiasts in the area to obtain components and products.

Robin Hall, Editor

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NEWS REPORT

Software makes Internet Phone Calls Easy

Software developed by Lucent Technologies is designed to give Internet callers quicker access to one another and allows them to converse via their computers as if they were on a regular speaker-phone. Previous software has been half-duplex, similar to a radio channel, whereby one party must stop speaking before the other can use the line. Lucent plans to market the software to AT&T, the Bell companies and Internet service providers for distribution to their customers. By the end of the year, Lucent plans to enhance the software to enable users to video conference over the Internet.

For further details, check: `http://www.lucent.com`.
Contact: Lucent, Tel: (01344) 865900.

3DO Gets Out of the Hardware Business

Video game maker, 3DO has surprised the IT industry with its announcement that it will sell all or part of its hardware business by the end of the year, and concentrate instead on making game software for PCs and the Internet. The company has invested millions of dollars developing its Interactive Multiplayer, but was never able to compete effectively against Japanese rivals Sega and Nintendo. 3DO this month unveiled its first PC games, which can be played over the Internet and will come bundled with Netscape's Navigator Web browser.

For further details, check: `http://www.3DO.com`**.**
Contact: 3DO, Tel: +1 (415) 261 3000.

Boom for Export Test Equipment

Orders for Racal's digital radio test equipment to the expanding GSM markets in the Far East have reached record levels. The company claims that the equipment supports both base station transceiver station (BTS) installation and the GSM infrastructure from countries throughout the region, where the growth in the number of digital cellular subscribers has increased at a rate of 105% per year since 1994.

For further details, check: **http://www.racal.com**.

Contact: Racal,
Tel: (01344) 388067.

Experimental 3D TV First

The Independent Television Commission and other members of the MIRAGE consortium have collaborated to produce what is believed to be the world's first stereoscopic 3D television program made for general viewing.

The 25-minute programme 'Eye to Eye' was made by TeleVirtual in association with AEA Technology and the ITC was shown publicly for the first time at the International Broadcasting Convention in Amsterdam on 12th September.

The programme is in the style of a documentary and was predominantly shot at the studios of Anglian Television in Norwich using digital production and a 3D studio camera. Three dimensional scenes range from Shakespeare to a shot from a rally car, using a miniature rugged 3D camera developed by the consortium.

The programme also includes scenes showing the potential for special effects, and a 3D virtual studio which looks realistic, but only exists as a model within a computer.

Nick Lodge, ITC's Head of Standards and Technology told *Electronics and Beyond*, "Digital Television will soon make it economical to deliver thousands of television channels to the home – far more than can be filled with traditional scheduled television programming. This is exciting because it will create opportunities for innovative and minority interest services, of which 3D television is just one".

"Although you need a special display, the feeling of actually being in the back of a rally car or at the exotic location in a travel log is quite an experience", added Lodge.

Contact: Independent Television Commission, Tel: (0171) 255 3000.

Long Life Blue-Green Lasers Could Double CD Capacity

A team of researchers at Sony's Research Centre at Yokohama in Japan has made a laser that could help to cram more information on to a compact disk. Several research teams are working toward the goal of semiconductor blue-green lasers, but until now, their lasers have been short lived.

In a paper in 'Electronics Letters' published by the Institution of Electrical Engineers (IEE) in the UK, Satoshi Taniguchi, Tomonori Hino, Satoshi Itoh, Kazushi Nakano, Norikazu Nakayama, Akira Ishibashi and Masao Ikeda of the Sony Corporation Research Centre report that they have made a laser that operated at room temperature for more than 100 hours. This is an improvement of about ten times on earlier lasers using the same materials.

"Requirements for higher density recording by optical disks and for thin and flat full colour displays are increasing", says Taniguchi. "Blue-green laser diodes could be the key device meeting these requirements", he adds.

Tiny lasers are used in compact-disk players and computer CD-ROM machines. Lasers detect digital information recorded as a series of pits in a reflecting surface. The amount of information that fits on a CD depends on the colour of the light used to retrieve it. Blue-green lasers can pack in at least twice as much information as the infra-red lasers in today's generation of CDs.

For further details, check: **http://www.iee.org.uk** or **http://www.sony.co.jp/CorporateCruise/News/96D-014E.html**.

Contact: IEE, Tel: (0171) 344 8403.

NEWS BYTES

Motorola to Sell Mac Clones

Motorola is set to introduce a line of personal computers running Apple's Macintosh operating system, with plans to sell the machines throughout the world. The company is also introducing a new line of PowerPC-equipped computers running Microsoft's Windows NT operating system. The two product families are expected to merge into one by September 1997.

For further details, check: http://www.motorola.com.

Contact: Motorola,
Tel: (01753) 575555.

Fix-it Resolves Computer Conflict

Fix-It is a troubleshooting utility that automatically finds and fixes software conflicts and hardware configuration errors – the leading causes of Windows '95 problems.

On start-up, the utility from Quarterdeck automatically performs an inventory of the user's entire computer, including applications, games, utilities, Internet browsers, modems, network cards and drivers. The program looks for missing application files, conflicts between applications or hardware, improper settings and Windows system problems, such as invalid registry and system entries.

Targeted at Windows '95 users, the tool, priced at £39, compliments Quarterdeck's WinProbe '95 hardware diagnostics utility.

For further details, check: **http://www.quarterdeck.com**.

Contact: Quarterdeck,
Tel: (01245) 496699.

Network Computer Announced by IBM

IBM has announced its first network computer (NC), a sub-£400 computer platform for conducting Internet-based business. The IBM Network Station offers plug-and-play simplicity and an intuitive Windows-style graphical interface, but is managed through a server network for both Internet-related and traditional business applications. This can reduce hardware, software and management expense by 50 to 75% over traditional personal computers.

A recent Gartner Group survey said a networked personal computer (PC) costs about $11,900 annually to own – including expenses for software upgrades and administrative services. IBM – like other manufacturers focused on building NC platforms – hopes to slash this cost.

For further details, check: http://www.ibm.com.

Contact: IBM,
Tel: (0171) 202 3799.

NEWS BYTES

Windows Goes Palmtop

Microsoft's new Windows CE software looks and works like Windows '95, but is designed to run on limited-memory, hand-held computers. More than 40 hardware and software companies, including Hitachi, Hewlett-Packard, SkyTel, Casio Computer and Symantec have endorsed the new system, and Casio and HP have said they will use Windows CE in new hand-held devices. The machines will be able to share information with Windows-based PCs and link to the Internet using Microsoft's Internet Explorer software.

For further details, check: `http://www.microsoft.com`.

Contact: Microsoft, Tel: (01734) 710021.

Guide to Mobile Communications

Toshiba has launched a free guide to mobile communication, called 'The Complete Guide to Mobile Data'. The guide provides an insight into how the mobile data market has developed, covers the current status of the various technologies in use and offers an insight into the way in which these technologies will continue to develop and mature.

For further details, check: **`http://www.toshiba.com`**.

Contact: Toshiba, Tel: (01932) 828828.

Beat Commuter Misery

Tube and rail strike misery and the knowledge that the average commuter spends almost a working day commuting each week is enough to make many more people want to work from home.

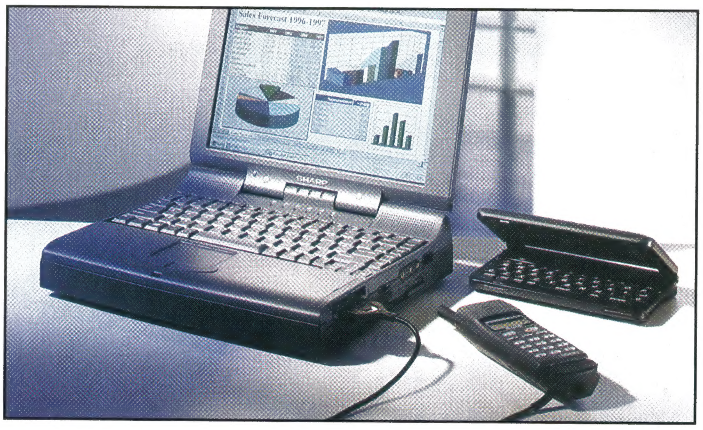
To help those who are tempted, Telework, Telecottage and Telecentre Association (TCA) have worked together with Hewlett-Packard, Lloyds Bank, BT, insurers Tolson Messenger and the European Union to produce the first comprehensive Teleworking handbook.

This book, priced at £13.95, gives advice on every aspect of working from home – from business ideas to company teleworking. It also offers guidance on telecottage centres, where homeworkers have access to computers and hi-tech equipment plus a special section for disabled teleworkers.

According to the Department of Transport, London commuters take an average of 57 minutes to get to work – adding up to ten hours a week, which is more than a working day. Throughout the rest of the country, the average travel to work time is almost half an hour – adding up to five hours a week.

For further details, check: `http://www.tca.org.uk`.

Contact: Telework, Telecottage and Telecentre Association, Tel: (0800) 616008.



Sharp Notebooks at Sharp Price

The number of people that can afford to spend £3,000 upwards on a portable PC must be fairly limited. Clearly, Sharp is more optimistic about the purchasing power of its target audience for its two new notebooks, the PC-9040 and PC-9070.

So what does £3,000 buy you? Sharp reckons to have developed the next generation portable PC.

The machines do have a neat colour display, a fast processor, CD-ROM drive and internal sound systems, but are lacking in basics such as a fax/modem and rapid battery recharge capability, which you'd expect for this price.

But to be fair, Sharp is offering a three year return-to-workshop warranty which features helpdesk, fax, courier collection and return delivery at Sharp's cost with a five working day turnaround.

For further details, check: **`http://www.sharp-usa.com`**.

Contact: Sharp, Tel: (0161) 205 2333.

Stronger ARM

Digital has announced new versions of its StrongARM SA-110 microprocessor that take StrongARM performance beyond 250 million instructions per second (MIPS). The new versions of the StrongARM SA-110 microprocessor operate at 233MHz and 166MHz. The SA-110 233MHz processor couples the large, on-chip cache and fast bus interface of the original SA-110 with a higher-speed pipeline to deliver performance estimated at 270 Dhrystone 2·1MIPS, five to ten times that of competitively priced devices.

For further details, check: `http://www.digital.com` **or** `http://www.arm.com`.

Contact: Digital, Tel: (01734) 868711.

BT Launches Windows Phone Disc

BT has introduced a Windows version of Phone Disc – the range of CD-ROM based telephone directory services providing access to the 17 million listed UK business and residential numbers.

Aimed at customers searching more than 20 numbers per week, the Windows Phone Disc works with Windows 3.1 and is available in either stand-alone or networked versions. The annual version is priced at £199, while the networked version costs £400 per quarter.

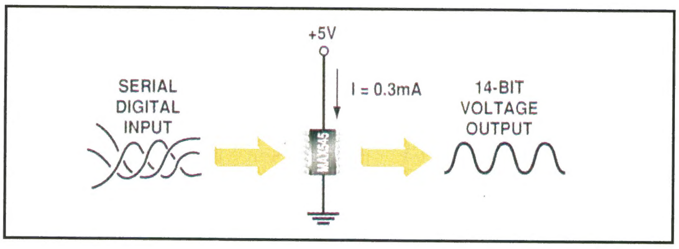
For further details, check: **`http://www.bt.com`**.

Contact: BT, Tel: (0800) 919199.

Serial DAC offers Lowest Power

Maxim, has launched a serial 14-bit digital to analogue converter which operates from a 1·5V supply, and consumes a minimal 1·5mW of power. The MAX545 handles digital data via a 3-wire interface, compatible with SPI, QSPI and Microwire standards. For bipolar operation, the device has scaling resistors which work with an external precision op-amp, such as the MAX400. On start-up, unwanted output voltages are cleared by an internal power-on reset circuit which clears the DAC output to 0V, when a voltage is first applied.

Contact: Maxim, Tel: (01734) 303338.

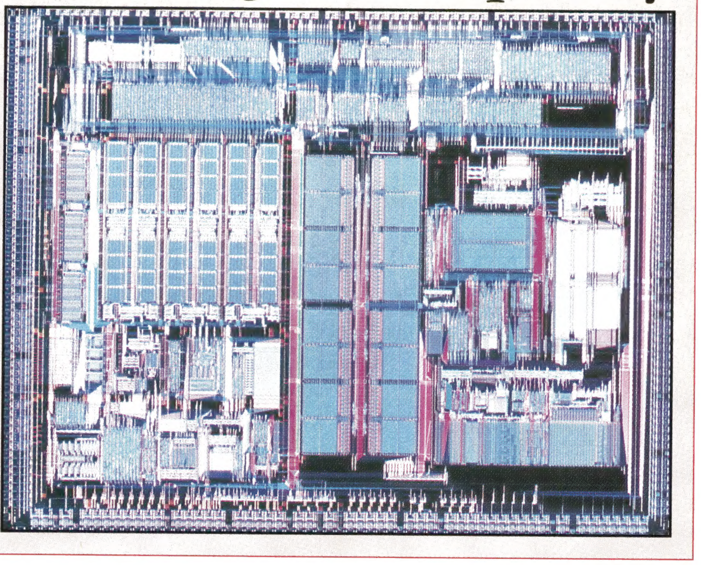


Arm Gets Speech Recognition Capability

Motorola's Lexicus Division has ported its small-memory speech recogniser to the Advanced RISC Machines (ARM) family of microprocessors. The ARM-based speech recogniser has demonstrated 99·8% accuracy in quiet, office environments. Other tests have shown it to have an average recognition rate of 96% in high noise environments, such as in a car with the stereo on and the windows open.

For further details, check: **`http://www.arm.com`**.

Contact: Advanced RISC Machines, Tel: (01223) 400400.



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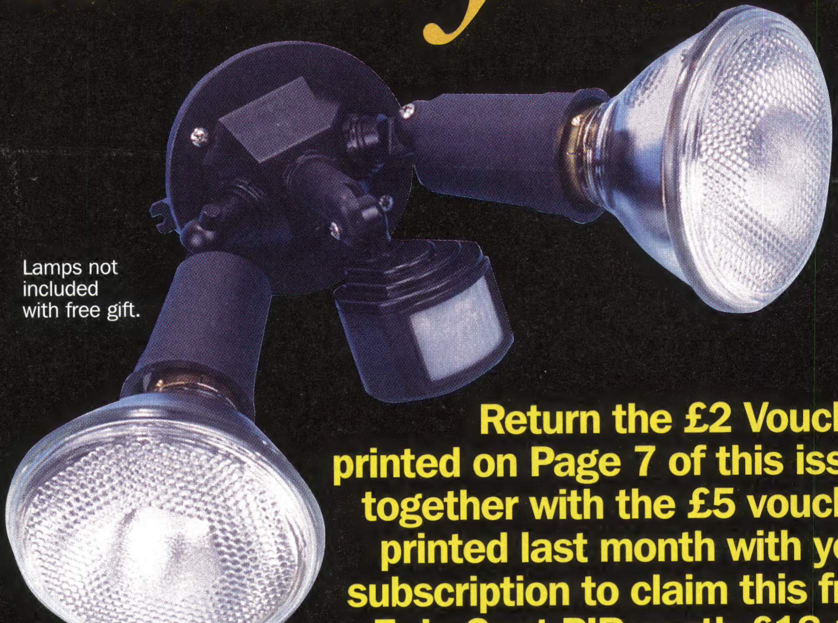

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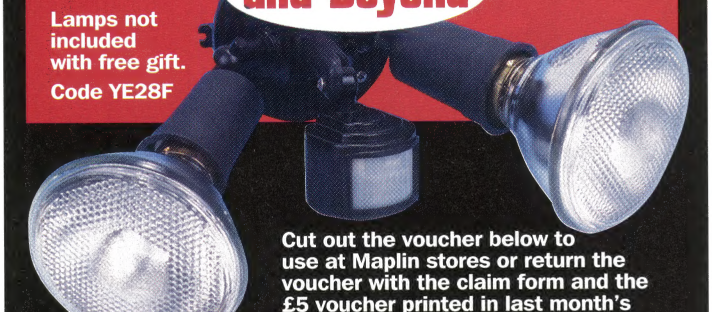

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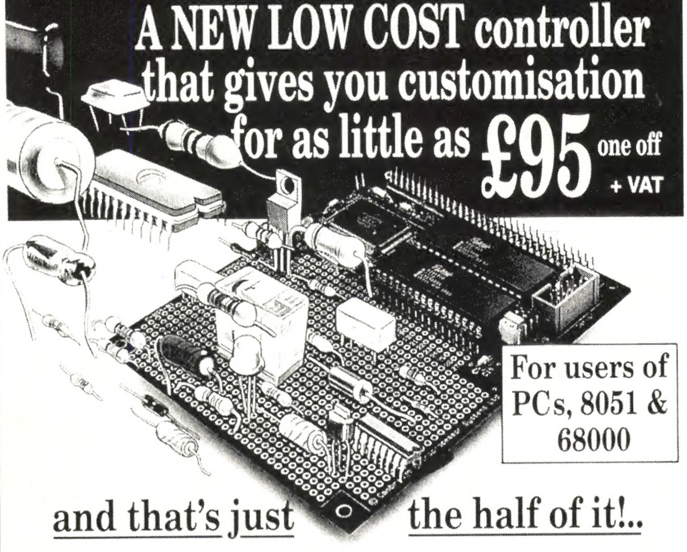

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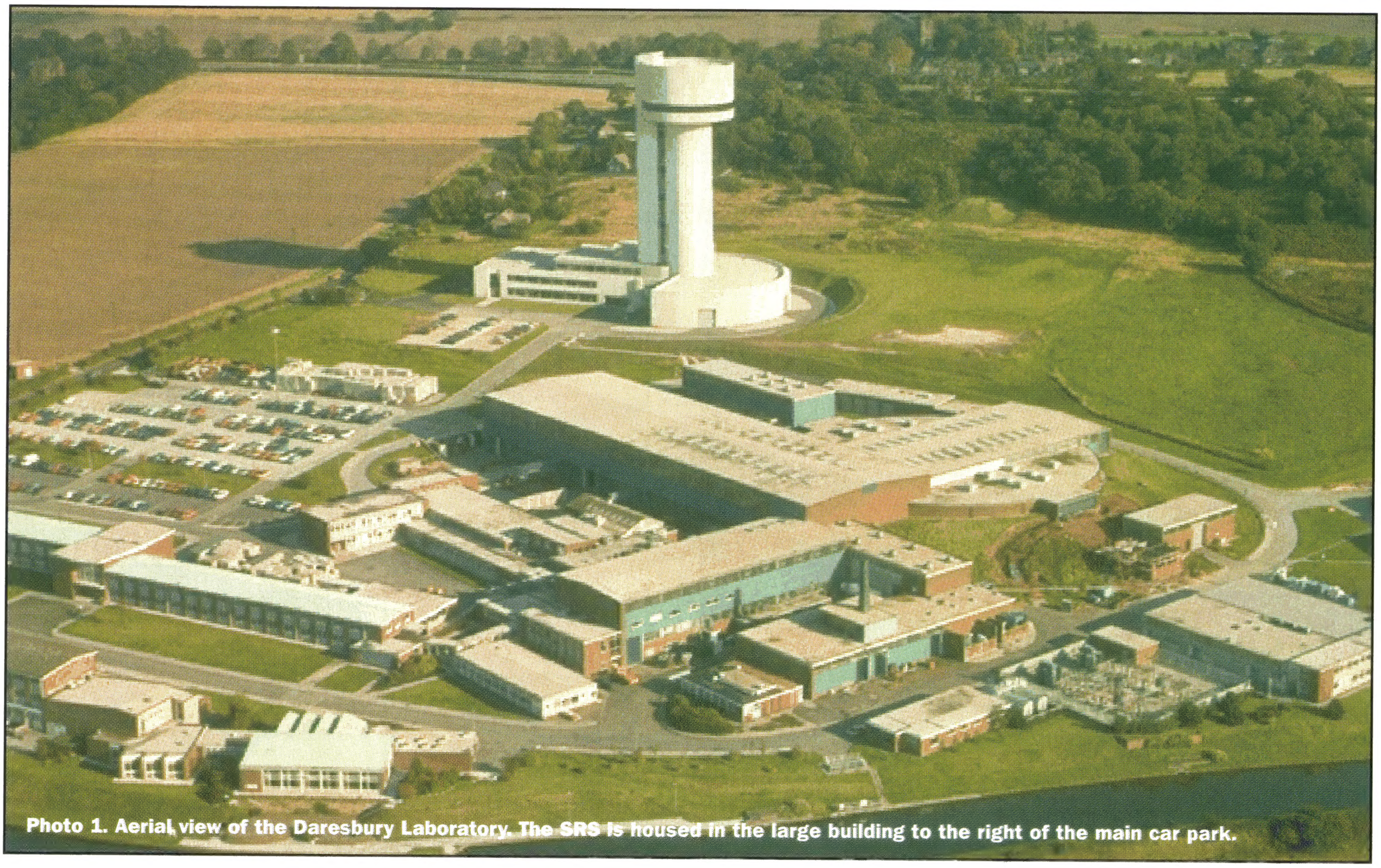
Photo 1. Aerial view of the Daresbury Laboratory. The SRS is housed in the large building to the right of the main car park.

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The Ring of Dazzling Light: THE DARESBURY SYNCHROTRON

by Douglas Clarkson

The Syncrotron Radiation Source (SRS) at Daresbury Laboratory near Warrington is the world's first dedicated source of high energy synchrotron radiation.

Daresbury Laboratory is part of the Council for the Central Laboratory of the Research Councils and is a 'twin' with the Rutherford Appleton Laboratory at Didcot (see Issue 104).

Photo 1 shows an aerial view of the laboratory. The SRS is housed in the large building to the right of the main car park.

Since its completion in the 1970's, numerous other synchrotrons have been completed around the world. In Europe, the 6GeV AERF facility has been constructed at Grenoble in France. Several new systems are in the process of construction, especially in Pacific Rim countries such as Japan. The technology of superconducting magnets has made it possible to construct considerably more compact devices for specialist applications such as the HELIOS system developed by Oxford Magnets with considerable input from the SRS team at Daresbury.

First Principles

When an electric charge such as an electron experiences an acceleration it will tend to radiate electromagnetic radiation. This is of course the principle utilised in radio and TV broadcasting systems where electrons are accelerated at a carrier frequency with appropriate signal modulation.

Where an energetic electron is fired at a target of 'heavy' atoms such as Tungsten as used in an x-ray machine, the energy of the

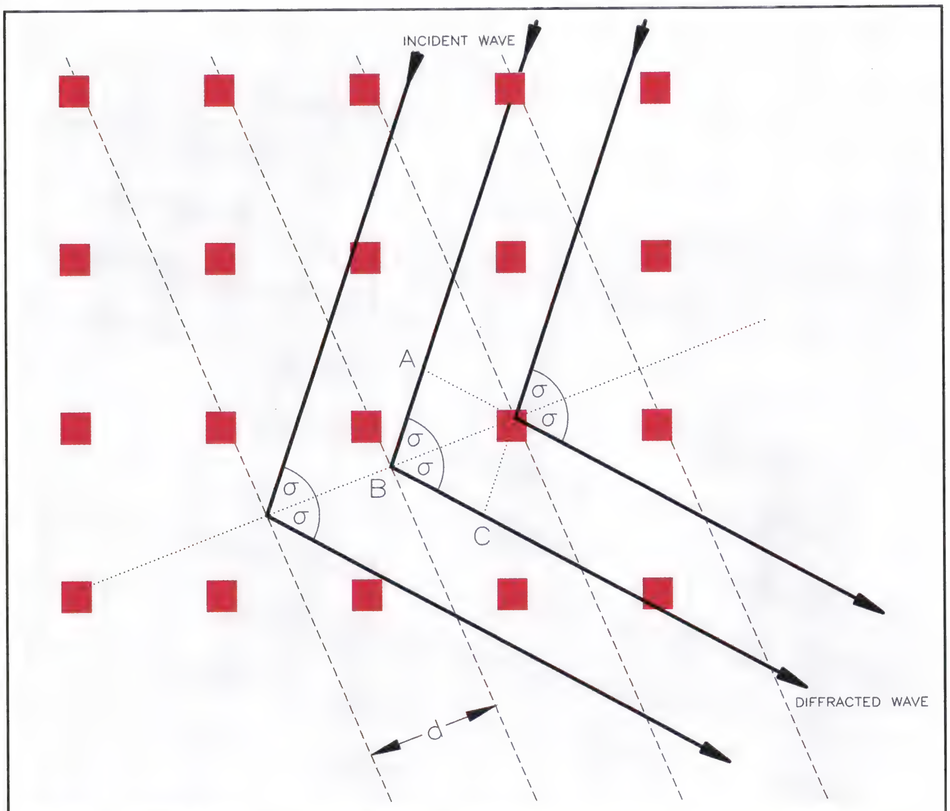


Figure 1. Bragg's Law: If the difference in travel of two points of the wavefront at angle of incidence O, AB + BC is equal to a whole number of effective wavelengths, then re-inforcement will take place.

electron is given up in a series of atomic collisions as the electron experiences violent de-accelerations. A component of the loss of energy of the electron at each stage is converted to photons of corresponding x-ray energy.

When an electron passes through a strong magnetic field the particle can experience a force the magnitude of which is proportional to the field strength and the electron velocity. Maximum force is experienced where the field direction is at right angles to the velocity of the electron. This component of force introduced from a magnetic field can cause a sufficiently energetic electron to radiate electromagnetic radiation.

This is the principle of the synchrotron which usually consists of a ring of elements to accelerate electrons and with bending magnets to flip the output of one accelerating stage into the axis of acceleration of another. The 'ring' is typically a regular polygon.

X-Ray Diffraction

A key property exploited extensively by the SRS at Daresbury is that of x-ray diffraction where x-rays are scattered off patterns of atoms. It was the German physicist Max Von Laue in 1912 that first demonstrated patterns produced by diffraction of an x-ray beam through a crystal. Von Laue had anticipated such a phenomenon as analogous to the diffraction obtained with light diffraction patterns. However, Laue's group was unable to relate the patterns obtained to the geometry of the diffraction crystal. In England, Sir Lawrance Bragg was in his mid twenties and completing his studies in Physics at a time when his father was investigating the ionisation of gases by x-rays. The keen young mind of Bragg junior was able to relate the patterns obtained by Laue to reflections from planes of atoms within the crystal structure.

Figure 1 indicates photons incident at an angle 0 to a crystal plane direction in a crystal. If the path difference AB + BC is an integral number of wavelengths, then the diffraction radiation will re-inforce. This condition, known as Bragg's Law can be expressed as:-

$$2\ d\ \sin O = n\ w \qquad n = 1,2,3\ \text{-----}\ (1)$$

where d is the vertical separation of the crystal planes, and w is the effective wavelength of the x-ray radiation.

The simple Bragg equation allowed the structure of many inorganic structures to be rapidly determined. The technique of determining molecular structure based on such x-ray diffraction patterns has steadily developed from the 1920's. Complex software packages have been developed to analyse diffraction patterns by spatial arrangement and relative intensity.

The Daresbury Laboratory has been a key player in the development of a range of software packages for specific application areas in x-ray crystallography. Several software systems have developed under the wing of so called Collaborative Computational Projects (CCPs) at Daresbury.

Thus CPP4 is a collaborative group involved in protein structure analysis with over 310 installed sites around the world. Also CCP14 provides a framework for software for powder and single crystal diffraction with CCP13 being developed for analysis of polymer and fibre diffraction. Thus researchers in these fields have today access to considerable accumulated scientific expertise.

The Daresbury Synchrotron

Electrons are initially injected into the ring at a relatively low energy of 600MeV from a small storage ring which in turn is supplied from a conventional linear accelerator. The electrons may be introduced as a single 'packet' or as a series of packets distributed evenly round the ring. The choice depends on the nature of the experiment being undertaken. A total of 160 electron bunches can be injected into the SRS electron beam. The relative bunching of the electrons determines the periodicity of pulses of radiation produced at each radiation extraction point.

Electrons are normally injected into the ring at the beginning of the day and ramped up to an energy of 2GeV. Once the electrons are ramped up to this level of energy it is not possible to top the beam up since these would only be injected at 600Mev and could not be sustained in the field geometry of the 2GeV electrons. There is some residual loss of electrons due to scattering from the beam and from collision from residual gas molecules within the vacuum chamber.

When the electrons are initially introduced into the main ring, the field strength of the dipole bending magnets is sufficiently strong to maintain the beam within the ring. As radio frequency power is supplied to the various accelerating stages the velocity of the electrons increases towards the speed of light and the mass of the electrons increases also in accordance with relativistic calculations. During this process the field strength of the magnets is increased to maintain beam geometry.

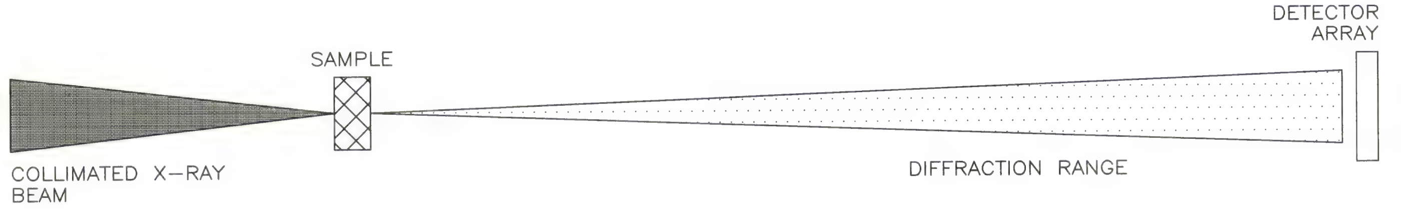


Figure 2. Basic features of experimental stage.

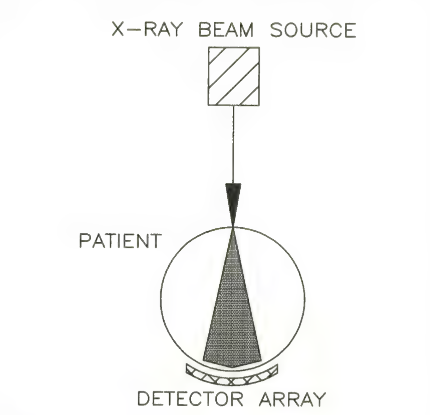


Figure 3. Basic principle of the CAT scanner.

At each of the 16 dipole points the electron beam radiates intensely over a broad range of electromagnetic wavelengths as indicated in the SRS data curves in Figure 5. Ten of these ports act as 'pick up points' for the radiation emitted by electrons bent in the magnetic field. These in turn act as inputs to around 30 experimental stations.

While the number of conventional bending dipoles is determined by the essential synchrotron geometry, it is also possible to include so called 'insertion' devices in the configuration in the straight sections between the bending dipoles. These insertion devices act to locally perturb the electron beam in order to produce additional sources of synchrotron radiation.

The so called 'undulator' magnet is essentially a stack of permanent magnets that introduces a field that produces a periodic field pattern. Such a configuration produces a narrow beam of soft x-rays. The so called 'wiggler' magnet uses superconducting technology to produce field perturbations to produce x-rays of higher energy. The system at present supports one undulator magnet and two 'wiggler' magnets (see SRS W16 curve of Figure 5).

When the SRS at Daresbury was initially designed and constructed, the technology of such insertion devices had not been anticipated. In more modern systems, the length of the straight sections has been significantly increased to facilitate the inclusion of such devices both initially and in any subsequent upgrades.

One of the stations, SRS station 16.1, supplied by x-rays from a wiggler device is shown in Photo 3. In summary, the station resembles a shooting gallery in a vacuum as indicated in Figure 2. The output from the syncrotron radiation is targeted with great precision on to a target (on far left) which can be accurately rotated at a range of selected angles. The entire system up to the detector array is maintained at ultra low vacuum. The distance between the sample is typically up to 10m though some specific experiments may have distances up to 50m or more. Scattered radiation is detected by a specialised radiation detector shown on far right of the assembly. This radiation detector system can detect individual scattered photon events in real time. The vacuum chamber at station 16.1 from the target to the detector interface 'telescopes' so that diffraction patterns over different 'target – detector' distances can be investigated. The target stage can be rotated accurately through various angles and the corresponding diffracted field pattern captured by the detector system. Once the data has been collected from sufficient angles, complex computer software processes the data according to experimental objectives. This provides information about constituent atoms and their relative position within the sample.

A new system of beam control has been recently implemented to allow positioning to an accuracy of 10 microns for the various beam lines. This has involved increasing the accuracy of measurement of beam line position using 16 bit A/D detectors compared with previous 12 bit devices.

The drift of the beam is primarily due to thermal cycling of the SRS over the 24 hour period. There is increasingly a key requirement of having good foundations to support synchrotron systems since any movement or flexing of heavy lifting gear around the ring structure can result in distortion of beam alignment.

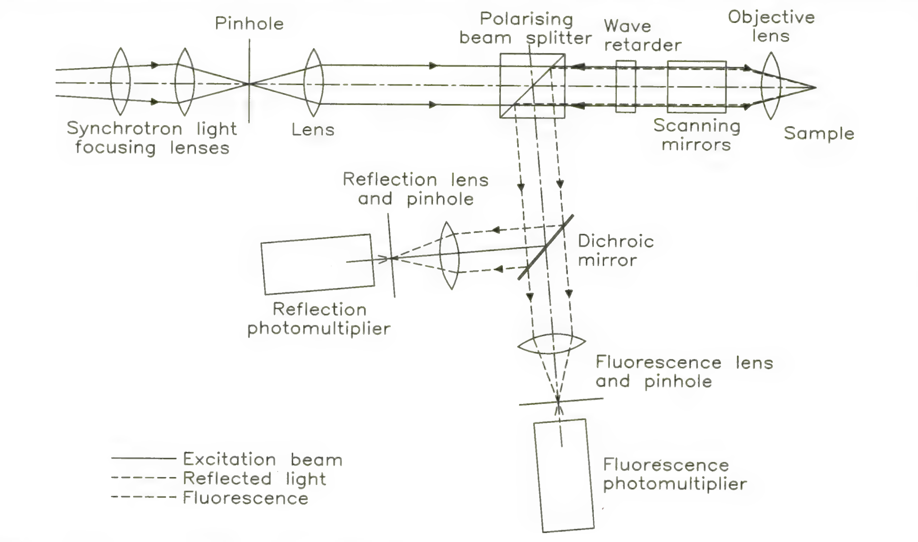
Detector Technology

The detector technology is a vital component of data collection. With experimental time at the various stations being a valuable commodity, there is an advantage in reducing the time required to capture data.

The basic type of detector utilised in con-crystalline diffraction stations are designed and built by the SRS detector group. The basic type of detector utilised is that of the multiwire proportional counter (MWPC). Individual photons are detected by the ionisation they produce in the vicinity of discrete wires placed close together and in a strong electric field.

The use of delay line circuitry allows resolution of separate (X,Y) co-ordinate of each photon ionisation event. Conventional delay line circuits tend to limit detection rate to around one million counts per second. In a development of this technology in the so called MWL3 system, separate instrumentation on each channel now allows an increase in speed (in theory to 200 million events per second).

An additional development is that of RAPID the fast 2-D detector system where ultra fast A/D data capture on each detector co-ordinate allows data capture at rates of up to 10 million events per second and with positional spacing of 1/8th of the spacing between the wires or stripes.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- - - - - - Reflected light
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Figure 4. Operational diagram of SYCLOPS.

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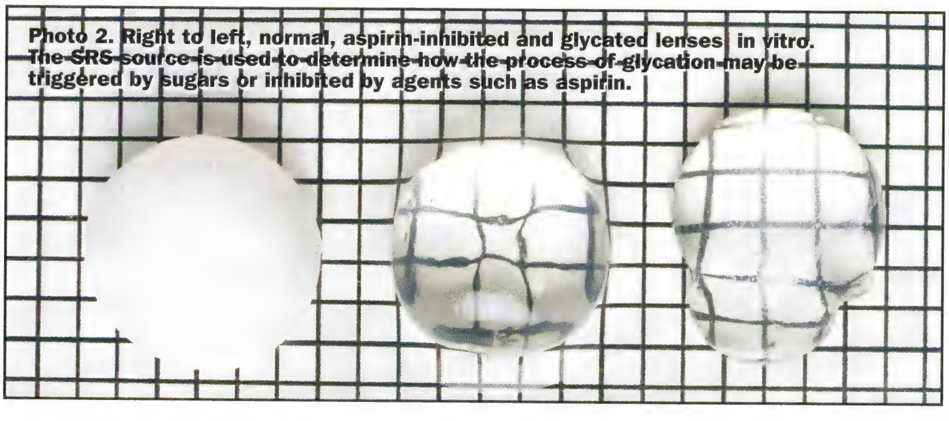

Photo 2. Right to left, normal, aspirin-inhibited and glycated lenses in vitro. The SRS source is used to determine how the process of glycation may be triggered by sugars or inhibited by agents such as aspirin.

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System Utilisation

The trend in modern scientific research is to utilise well developed facilities that are shared by a wider group of users. Around 600 separate projects at present take time on the SRS involving around 2,400 researchers. Around a quarter of this activity originates from outside the UK as summarised in Table 1.

Country	% of Non-UK Use
Belgium	4
Germany	26
Denmark	4
Netherlands	15
Greece	1
Italy	12
France	13
Portugal	4
Spain	16
Ireland	5

Table 1. Summary of percentage of non-UK use of SRS for periods during 1994. Also, the SRS is used across a broad range of disciplines.

Utilisation of the SRS facility is relatively high with an operating efficiency of 88.4% with allowance for injection time of the beam. The facility is run for around 6,000 hours per year. Each of the experimental stations is managed by a specific local 'manager' who ensures that beam characteristics meet the specification of users of the system.

Safety Considerations

As the beam is introduced into each experimental 'hutch' for the process of data collection, the high levels of ionising radiation require all workers to withdraw behind doors and wall lined with thick layers of lead. Special attention has in particular to be paid to adequate sealing of doors to ensure that radiation does not leak out. Also, cables and controls between control rooms and 'hutches' require to be routed through special purpose conduit enclosures to prevent radiation leakage.

Unravelling Photosynthesis

One of the earliest functions developed by bacteria in the 'primeval soup' was the process of photosynthesis where photons of light from the sun are used as 'energy' to initiate chemical reactions. A group at Daresbury Laboratory in association with researchers at Glasgow University has succeeded in determining the molecular structure of the light harvesting complex of a purple photosynthetic bacterium – Rhophseudomonas acidophila. This organism can be readily found as a purple scum on polluted waterways in North America. Studies of this most ancient of organisms, have revealed the elegant way in which incident photons of light are captured by the harvesting complex.

The reaction centre of the bacterium cannot manage photosynthesis on its own due to incident light photons. It depends on the harvesting complex to collect and distribute energy to it in sufficient amounts to enable it to achieve conversion of the chemical ATP. The 'chromophore' regions in the light harvesting complex rapidly absorbs individual photons. The energy from a specific photon is in turn channelled through other chromophores until it eventually is made available at the central reaction site.

The proteins involved in the photosynthesis process reside in the actual membrane of the bacteria. The isolation and collection of such cell membrane proteins is a notoriously difficult procedure necessitating the use of exceedingly minute samples. Use was made at Daresbury of 'wiggler' station 9.6 of the Synchrotron Radiation Source. This station is primarily used to its very high output levels of x-rays to obtain the data in the diffracted x-ray patterns.

The efficiency of the light harvesting of the bacterium approaches 95%. A total of 8 light harvesting complexes (LH2) are configured round a single LH1 complex. Light energy is captured within the peripheral centres and raise the energy at the reaction centre. Thus even a so called crude organism is actually a masterpiece of molecular engineering.

Probing the Tissues of the Eye

The transparency of the cornea and the lens are crucial for effective vision. A range of clinical disorders can render these finely balanced optical structures non-transmitting to light. With an aging population, such problems are likely to increasingly manifest. Considerable work, primarily funded by the Medical Research Council, has been undertaken to investigate how various agents may be able to block such processes of tissue degeneration.

When 'normal' clear corneal tissue is probed using the synchrotron radiation, a highly ordered pattern of bundles of collagen is observed – like logs in a log pile all aligned in the same way. An imbalance of sugars in the body, associated for example with diabetes, tends to disrupt this high level of ordering, so that while the chemical composition of the strands of collagen remains similar, the physical arrangement of the strands of collagen is more random and accordingly less transparent. In fact, the sclera, the 'white' of the eye, is chemically indistinguishable from the normally clear corneal tissue.

The process of 'glycation' has been studied extensively at Daresbury in order to determine its specific mechanisms and also to investigate how it can be prevented. Photo 2 indicates, right to left, normal, aspirin-inhibited and glycated lenses in vitro. Glycation is inhibited by paracetomol. The use of aspirin and paracetomol is relevant only in the scope of understanding the blocking mechanism that they possess in such laboratory experiments. There is no suggestion that any level of such over the counter medicines will protect against the glycation process 'in vivo'. Such basic research could one day, however, lead to the prevention or better management of such disorders.

Discipline	% SRS Allocation
Material Science	28
Engineering	1
Biology	18
Chemistry	28
Physics	25

Table 2. Typical allocation of SRS beam time between main disciplines during 1994

Photo 3. SRS station 1[illegible] which is fed by a high performance wiggler device.

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The main component of the human lens consists of a range of proteins known as crystallins. The human eye contains a high proportion of gamma – crystallin. This is turn makes the lens relatively hard and less easy to distort during the process of fine focusing as the radius of curvature of the lens is changed.

The structure of delta – crystallin, the key component of the lenses of birds and which has recently been solved by workers at the SRS provides for a softer lens and one which is better adapted to rapidly changing shape to accommodate transitions between air and water environments in diving birds.

Clear corneal material is often used to effect a corneal transplant. The use of the synchrotron radiation at Daresbury has helped improve the outcome of corneal transplants. By 'reading' the axis of the direction of alignment of the collagen fibres in excised corneal transplants and matching this to the natural direction in the eyes receiving such transplants, the number of failed transplants has been significantly reduced.

Investigating Parkinson's Disease

A range of neurological disorders are thought to be associated with abnormal accumulation of various metals in brain tissue. While Alzheimer's disease tends to be linked with Aluminium, Parkinson's disease is thought to be associated with abnormally high levels of Iron. Thus while in a normal adult brain, levels of iron will typically be at a level of 50 micro grammes per gramme of tissue, in Parkinson's sufferers this figure can rise to values five times higher.

A neuroradiologist at Newcastle General Hospital and a team of researchers at Daresbury have used the synchrotron radiation source to try to identify the molecular form of iron in Parkinson related tissue. A complex molecular structure will tend to absorb x-ray photons in a way which is characteristic of atoms present and also their relative positions. Using the technique of Extended x-ray Absorption Fine Structure (EXAFS) the profile of the absorber was obtained using absorption data from the synchrotron beam. The experimental data obtained matched that of Ferritin – a complex molecule containing up to 4,500 iron atoms. This confirms that the additional iron is held in this molecular form. Parallel work using electron microscopy was also able to identify the physical appearance and distribution of Ferritin within brain tissue samples. While not directly solving the mystery of the development of this disease, the information obtained is however significant for researchers in this field.

Looking at Catalysts

While proponents of green technology can easily describe what they would like by way of clean, non-polluting processes it is often left to the scientist to patiently research new chemical reaction processes to bring this about. This is especially true in the case of advanced catalyst design.

The SRS has been used at Daresbury to optimise the configuration and test the performance of a series of so called ALPO catalysts – a branch of the zeolite family of catalysts. Attention has in particular been directed to the formulation of CoALPO-18 and its performance in reactions such as the production of propylene and ethylene when methanol is introduced into its reactive zones. The development of catalysts using conventional 'trial and error' technology can lead to lengthy development times for such products. By using the SRS at various stages of catalyst function, it is hoped that optimised products can more rapidly be developed. The development of such catalysts is obviously of major commercial importance to several key industries.

Microtomography

So called CAT scanners are now widely used in hospitals to image the internal composition of patients. The basic principle of the CAT scanner is indicated in Figure 3. An x-ray source delivers a narrow beam of x-ray radiation through the patient while rotating round the axis through the patient. At the same time the detector array rotates with the radiation source. The relative absorption at co-ordinates within the body is then calculated using so called back propagation algorithms. Such a technology can typically produce a resolution of the order of a mm - the characteristic of the size of features that can be distinguished.

The technique of microtomography takes advantage of superb geometry of the x-ray beam to image much smaller structures in a non-invasive way, entirely analogous to scanning a patient. Synchrotron radiation between 6keV and 30keV is typically used in this application with resolutions around 20 microns, some 50 times better than the conventional CAT systems.

A technique such as microtomography has obviously wide application. Initially the system has been used to investigate insect physiology. There is also interest in determining the structure of sandstone associated with oil deposits. This can provide valuable information regarding the scope for oil extraction from such strata.

SYCLOPS

The wide range of wavelengths of intense radiation available from the SRS has allowed development of a specialist confocal microscope system called SYCLOPS. Use is made of radiation between 200 and 700nm with appropriate interference filters being used to select a narrow band within this broad range.

The action of the confocal microscope is to image in selected planes through a sample. The SYCLOPS has been developed jointly by the Engineering Research Council (SERC) and the Netherlands Organisation for Scientific Research (NWO). The function of SYCLOPS is shown in Figure 4.

Using the confocal technique, images can be obtained from 'slices' across a specific cell. In this way, information on the spatial arrangement of components such as chromosomes within a cell can be obtained.

Using the mode of single bunching of the synchrotron, it has been possible to direct light to samples as small as individual cells in order to monitor biochemical activity. Even though laser technology has increased the range of lasers available and extended their range of wavelengths and output modes, the SRS provides a more flexible source of photons to investigate complex biological structures.

Investigating Muscle

One of the most basic of biological processes must surely be that of muscle contraction. Having such a key role in the universal scheme of things it might be assumed that all the associated processes involved had been solved years previously. Apparently, however, this is not the case. Recent work at Daresbury, however, using the high performance experimental station 16.1 has provided new insight into the process of muscle contraction.

X-ray diffraction is used to detect images from muscle in the relaxed and the contracted state. This in turn provides information on the change in ordering within the large molecules making up muscle. It is thought that muscle consists of myosin and actin filaments. The myosin possesses arm like branches which in the relaxed state are aligned about 60 degrees to the axis of the myosin filaments. When the muscle receives an electrical stimulation, the arms move forward to bind to the actin and in so doing the fibres slide past each other, causing the muscle to contract. Thus the combines strength manifested by muscle is made up of countless separate molecules/molecular interactions.

Making Plastics Attractive to Bugs

Nature, it seems, has many a solution to a range of problems of pollution. Each year at present around 100 million tons of plastic ends up on rubbish tips or dumped in landfill sites. Looking to the future, ICI is using the Daresbury SRS to investigate the properties of plastics created during a process of fermentation using sugars and specialist microbes. The plastics formed during such processes are in turn biodegradable.

The basic plastic product of this process BIOPOL is being extensively tested using the SRS source. It has been determined that the temperature at which BIOPOL is processed is a key parameter that determines its biodegradable properties.

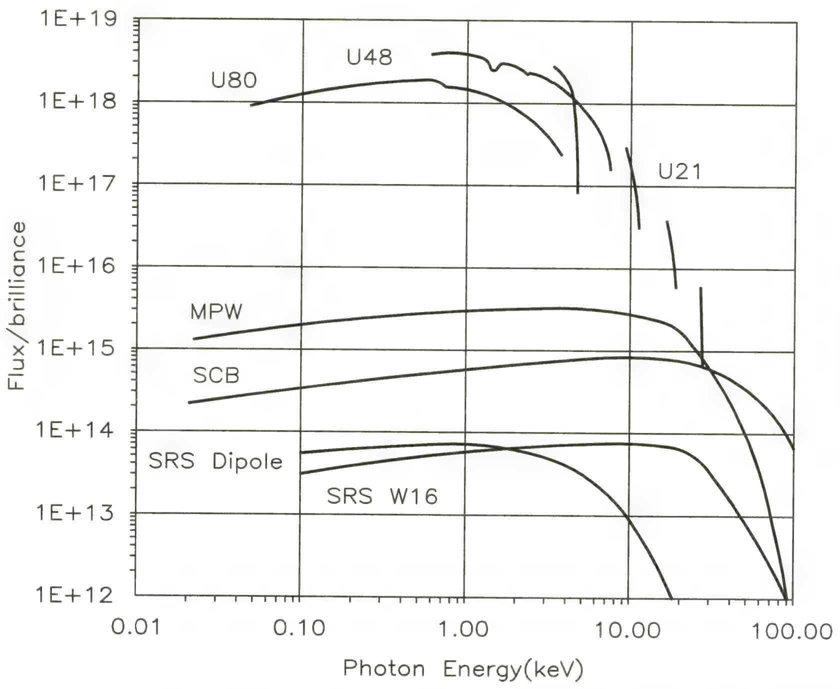

Figure 5. Estimated beam characteristics of DIAMOND compared with existing SRS system.

CLRC.

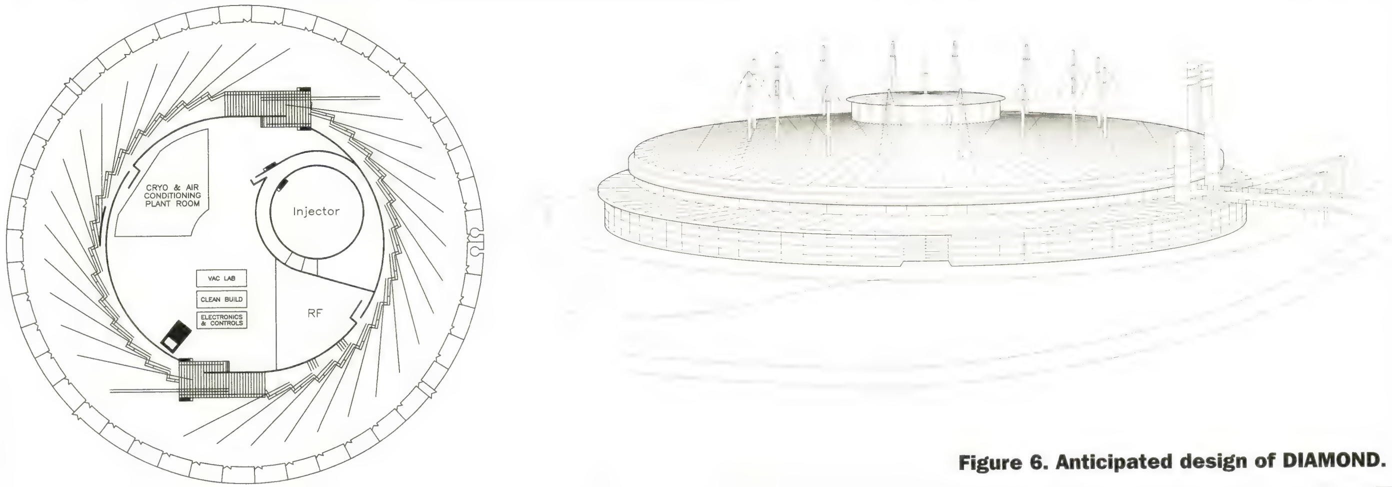

Figure 6. Anticipated design of DIAMOND.

CLRC.

The x-ray diffraction images obtained from samples processed at various temperatures provides a valuable indication of how molecular structures are configured with a view to optimising the manufacturing processes to develop a wide range of environmentally friendly plastics.

It should also be noted, that this specific process of plastic production involves primarily agriculture. Does this provide for another crop such as sugar beet to be grown on 'setaside' land to provide the necessary raw materials.

Crystals of Cobra Venom

Nature has provided the Cobra with an exotic cocktail of proteins in its venom, all of them poisonous. In an effort to develop new drugs to block the action of these neurotoxins, scientists at Daresbury are using the SRS to investigate the structure of one of the deadliest proteins present in cobra venom.

Using venom extracted from snakes kept at the Liverpool School of Tropical Medicine, the proteins in the venom are purified and crystallised prior to x-ray scattering investigations. This allows researchers to build up a picture of the overall protein structure with the prospect in the future of designing new drugs to block the action of the neurotoxin. The unravelling of the secrets of cobra venom developed in turn over countless millennia, will, however, take some time to unravel.

The Future's Bright – The Future's DIAMOND

The initial go ahead to build the SRS was given in 1975 and became operational on schedule during 1981. After some 15 years of high levels of utilisation, plans are being made for a new facility DIAMOND. With engineering specifications of DIAMOND now at an advanced stage, methods of funding are actively being investigated. The earliest the new facility could be completed by is estimated to be 2001, by which time the existing SRS will be over 25 years old. Figure 6 shows the present design of the DIAMOND facility and which it is hoped will be built at the existing Daresbury site.

Parameter	DIAMOND
Electron energy	3Gev
Beam current	300mA
Lifetime	20h
Circumference	338.4m
No. of cells	16
No. of bends	32
Bending field	1.4 Tesla
No. of insertion devices	12

Table 3. Key parameters of proposed DIAMOND system.

Figure 5 provides a useful comparison of the performance of the existing SRS and those proposed to use in the DIAMOND facility.

In the figure the data for SRS is that of the existing dipole magnets that bend the beam at each intersection between accelerating elements and SRS W16 is the existing performance of the superconducting wiggler (W16). The line SCB is the estimated performance of DIAMOND's superconducting bending magnets. It would be possible as part of a partial upgrade of the SRS, to use such bending magnets within the existing SRS structure. The line MPW indicates the performance of DIAMOND's multipole wigglers. The sections prefixed U indicate advanced undulatory sections of DIAMOND.

DIAMOND therefore provides considerably higher beam intensities and also extends significantly the top end of energy of delivered photons. It also provides more flexibility for addition of new insertion devices during any subsequent development.

Summary

The continual development of the beam parameters of synchrotrons and also detection systems together with sophisticated methods of numerical analysis has made such work with synchrotrons a key tool for the investigation of a broad range of physical phenomena. In particular, work in material sciences has especially benefited. It is to be hoped that the UK can maintain its eminent position in synchrotron based research and build upon its solid achievement of the past 20 years.

Further Information

Annual Report 1994 to 1995, Synchrotron Radiation Department, CLRC.
Annual Scientific Reports 1994 to 1995, Volume 1, Synchrotron Radiation Department, CLRC.
Annual Scientific Reports 1994 to 1995, Volume 2, Synchrotron Radiation Department, CLRC.

Points of Contact

Public Relations,
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Fax: (01925) 603100.

Internet Sources

Within the high energy physics community, the Internet is hardly a new phenomenon. The research facility at CERN, Geneva, has played a key role in its development. As a first point of contact, the home page of the Daresbury Laboratory is `http://www.daresbury.ac.uk`. This is a useful point of contact for many more displayed topics.

Contacts for Specific Topics

Unravelling Photosynthesis
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e-mail: `m.papiz@dl.ac.uk`

System Utilisation
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e-mail: `p.d.quinn@dl.ac.uk`

Probing Tissue of the Eye
Dr. K. Meek. Tel: (01865) 328185
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Parkinson's Disease
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DIAMOND
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Isolated Mains CONTROL INTERFACE

by Peter Bode of Abbey Electronic Controls

It has always been a preferable option to take electrical power directly from the mains rather than through a transformer for the obvious reasons that transformers are bulky and comparatively expensive items in electronics. In many cases where a transformer has been used it has been necessitated by either the need for low voltage isolation or the need to control a load that is unavoidably mains rated. The ZAX27™ can perform either role.

It is a fully isolated and elegant device for the accurate control of alternating current voltage of any amplitude up to 300V rms. It achieves this through a DC control voltage. The concept and principle of operation is quite simple as shown in Figure 1. Low voltage on one side of the module, high voltage and load on the other with the low voltage controlling or modulating the high voltage and providing total electrical isolation. In the simplest sense, the ZAX27™ could therefore be considered as a very compact infinitely variable isolating transformer. It is of course much complex and more versatile than that (as we shall see) and whilst the transformer is passive, the ZAX27™ is active.

The device operates in two modes, Phase Mode and Burst Mode. Which mode the device operates in is selected simply by the appropriate logic on a single MODE pin. An ingenious scheme allows certain pins to perform more than one function simply by applying different voltage levels to the pin. This has allowed the functionality of the ZAX27™ to be expanded without incurring extra I/O overhead.

Phase versus Burst Control

Both phase and burst control are well established methods for controlling alternating current voltages. Phase control is more versatile and suitable to a wider range of situations than is burst control. It however has the major disadvantage of being intrinsically very noisy. Where the electrical noise generated can not be eliminated (due to power level, for example) its use may be precluded by a suitable EMC filter such as the ZFM23/2k5 EMI Mains Inlet Filter (Stock Code CK24B).

Burst control on the other hand does not suffer from noise in the same way as phase control. It can work with full half sine wave cycles. This makes it possible to ensure the turn on point always coincide with the zero crossing point thus eliminating the main source of noise in phase control. Burst control is however inherently slower in response than phase control and is only suitable for systems with relatively fairly large inertia such as heaters, some motors, and the like. It would not for example be used in lamp dimming where there would be visible and very much unacceptable flickering.

Operation

The principle of operation is quite simple and follows the pattern that makes all well known components easy to use – predictability, precision, a well defined output for a defined input. The rms value of the AC output is a computable function of the value of the applied controlling DC voltage and the input AC voltage. The ZAX27™ maintains its output as a fixed ratio of the applied input voltage, the ratio being determined by the level of DC voltage applied to the device's control pin 5.

The DC voltage achieves this control by regulating the conduction phase (in phase mode) of the switching element of the ZAX27™ or (in burst mode) by proportionally allowing a number of half cycles of mains power to the load. Applications for the ZAX27™ include many mains operated devices which are able to work with phase or burst control. Among these are all resistive and inductive elements as well as some capacitive ones. The control of such elements directly from a microprocessor or microcontroller is now possible through the ZAX27™.

Closed Loop Application

The device has a further advantage in that it can also be used in a fully isolated closed loop design providing even better control than is possible with other controllers that work with similar principles. To aid in such applications, it has an integral, fully uncommitted, operational amplifier which can be used as an error amplifier or comparator.

Output Inhibit

In addition, the device has an in-built fully isolated load current regulation input which can be configured to limit either the peak or average load current. On the low voltage side, the ZAX27™ has an inhibit input which prevents any output from it when the pin is taken high, whatever the voltage is on the control input.

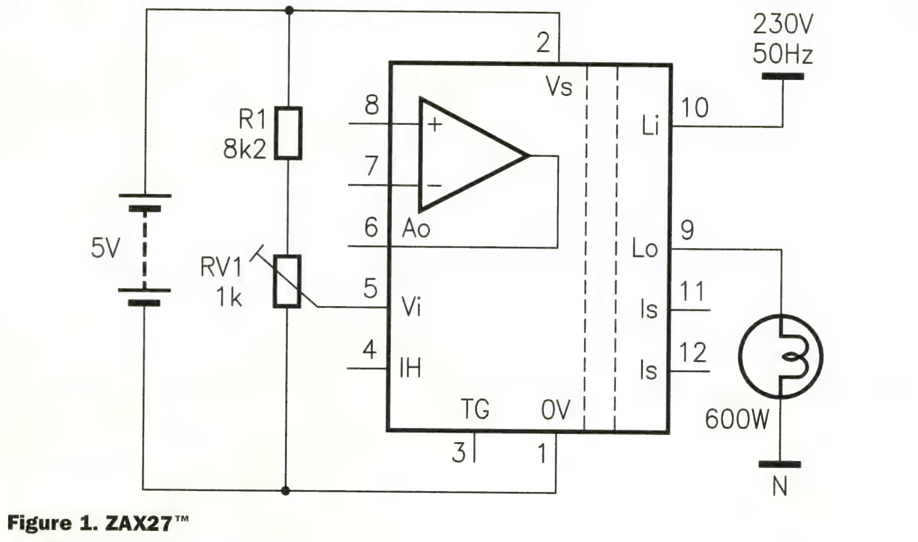


Figure 1. ZAX27™

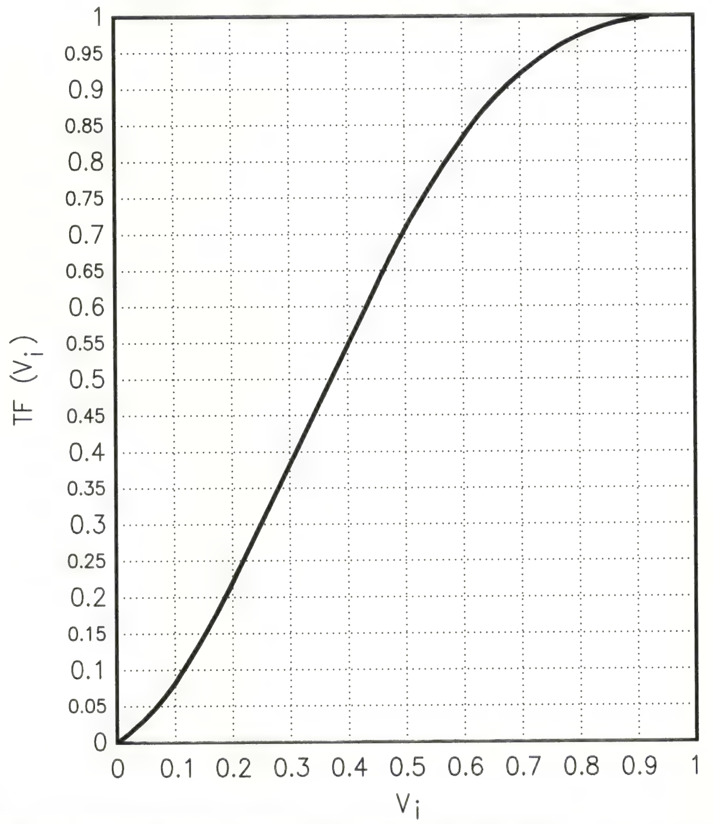


Figure 2. Curve of normalised Transfer Function for the ZAX27™ in its Phase mode V_o set to 0)

Overheat Shut Down

There is also the inclusion of an on-module overheat shut down facility. If the module's internal temperature should rise too high it will automatically shut down until it has cooled down to an acceptable limit before turning on again automatically.

Soft Start Facility

The ZAX27™ has a soft-start feature which will gently ramp up the power output from 0% to 100% over a period, typically 5 seconds. Should the control not be set to provide 100% power, the soft-start will ramp at the same rate but stop at the current power setting. The soft-start is active only at power up and following removal of an inhibit signal.

Applications such as motor speed control, automatic brightness control, regulation and pre-regulation of the supply to transformers in both linear and switch mode power supplies are among the many uses that the ZAX27™ can or has been put to.

In addition to the supply pins, the ZAX27™ only needs three other pins (1 for input and 2 for output) connected to be fully functional. Also, the DC power requirement is so low that the device can be powered from batteries if necessary.

Pins

The ZAX27™ has 12 pins, 8 on the low voltage side and 4 on the high voltage side. It may be useful to know that pins 9 and 10 are interchangeable. The same is true of pins 11 and 12.

DC Power Supply Pins (1 & 2)

A stable DC supply of 5V nominal should be applied to pin 2 with respect to pin 1. All parameters are quantified assuming this voltage. In applications where the control voltage is derived from V_s (such as Figure 1) the Supply Voltage Rejection Ratio (SVRR) defined as V_{rms}/V_s will be very good, theoretically 0%. If the control voltage is independent of the supply, then the SVRR is theoretically 100%.

Mode Pin (3)

A low logic (default) on the mode pin 3 puts the ZAX27™ into its burst mode whilst a high logic will put it into the phase mode.

Inhibit Pin (4)

The inhibit pin suppresses any output from the ZAX27™ when a logic high is applied to its input. The pin is also used to modify the input range of the module.

Following the removal of an inhibit signal, the output will remain inhibited for about 1s after which it will soft-start to the power level set by the control pin 5. This allows a settling time for other devices such as relays and contactors.

Control Input Pin (5)

The controlling pin 5 is by default set to a range of 0 to 1V DC to provide 0 to 100% power control. It can however be changed to a different range of 0 to 5V DC by applying 2.5V DC (or $0.5V_s$) to the inhibit pin 4.

In the 0 to 1V mode the device operates with 51 incremental steps thus providing a resolution of about 2%. This increment will be imperceptible and the resolution satisfactory in many applications. In fact it may be necessary for loads which are not very responsive.

If for any reason these performance figures are not satisfactory the 0 to 5V mode may be used. This provides 255 incremental steps and an average resolution of about 0.4%.

PHASE MODE (Pin 3 High)

Equation 1 gives the normalised transfer function governing the input/output ratio when the ZAX27™ is used in the phase mode.

$$TF(V_i) = \frac{V_{load}}{V_{mains}} = \sqrt{\frac{(2*\pi*(Vi-Vo)+\sin(2*\pi*(Vi-Vo))}{2*\pi}} \quad (1)$$

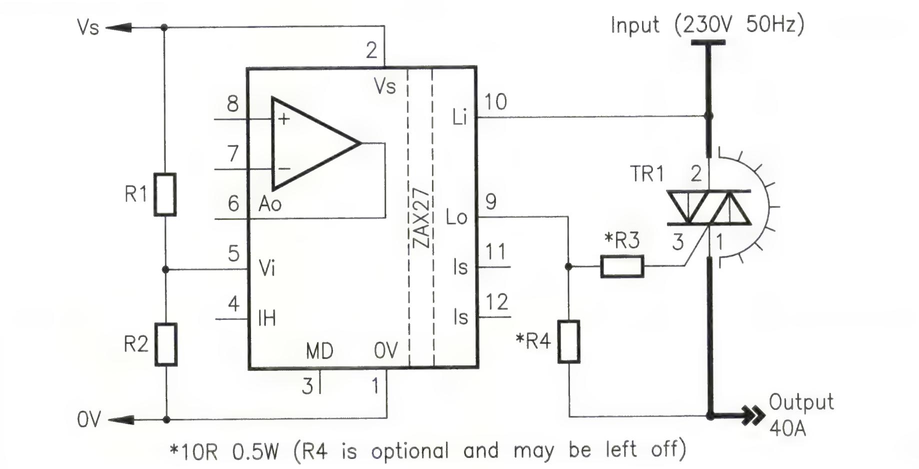
Where

V_{load} is the to the load and V_{mains} is the supply voltage, both in rms. v_i is the control DC input and v_o is a circuit constant.

V_o is effectively an offset voltage caused by components' as well as manufacturing tolerances. It can either be allowed for or it can be trimmed out by other external methods. This expression might look rather cumbersome but, as can be seen from the graph of Figure 2, it is quite easy to use.

BURST MODE (Pin 3 Low)

Equation 2 gives the simple expression governing the transfer function when the ZAX27™ is in its burst mode.



*10R 0.5W (R4 is optional and may be left off)

Figure 3a. Boosting the output drive capability of ZAX27A.

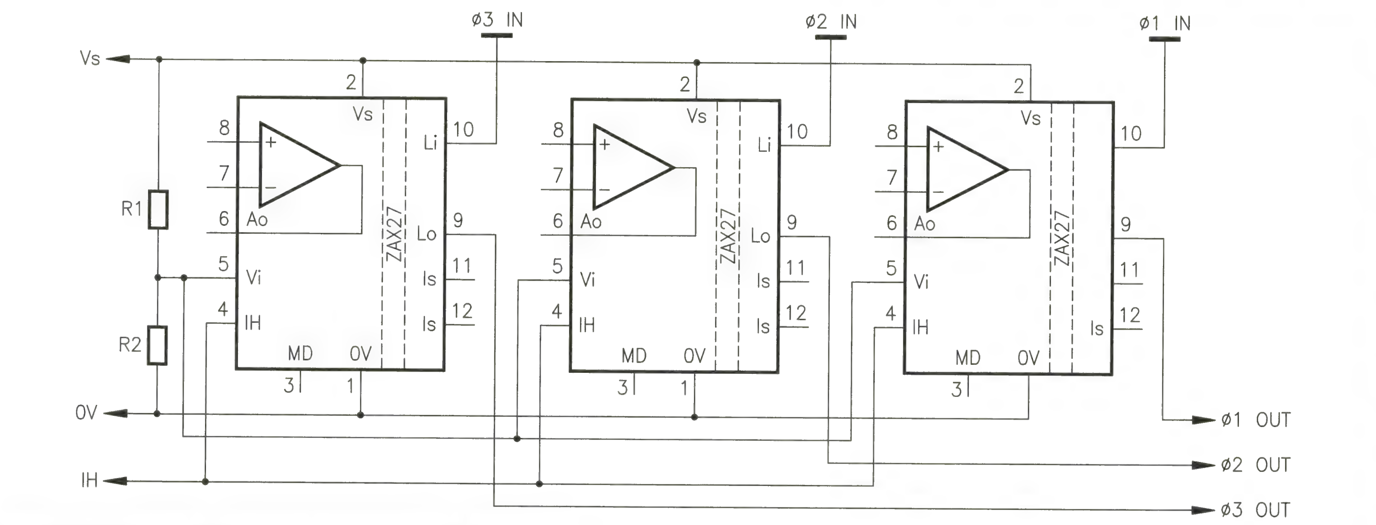


Figure 3a. Driving multiphase loads with the ZAX27A.

$P_{av} = k*V_i*P_{max}$ (2)

Where

P_{av} is the average power to the load, v_i is the control d.c. input which can be varied from 0 to 1V or 5V. k is a circuit constant (nominally unity), P_{max} is the maximum available power to the load.

The DC voltage achieves this control by 'burst' firing the switching element of the ZAX27™ on and off within a defined time frame or time base. Within this time base (nominally 1 second), the ZAX27™ switches its output on and off with a fixed mark/space ratio determined by the value of v_i as shown in Equation 2. The ZAX27™ is also zero-crossing switching. This means it will only switch its output on or off when the mains is passing through its natural zero. This virtually eliminates any noise that could be associated with mains switching and it is this single fact that may make the ZAX27™ a must in many applications.

The ZAX27™ only switches on and off once within a time base period. Furthermore, the minimum conduction period is determined by one half cycle of the mains which, for a 50Hz mains, is 10ms. This means the resolution of the ZAX27™, when operating with a time base of 1s, is 1% which is very good. Resolution in this case is defined as *the ratio of the minimum incremental conduction period divided by the time base*. On the other hand, switching on and off once every second may be too slow for some applications.

Provision is therefore made for variable time base on the ZAX27™. The minimum time base is 100ms which allows a maximum of 10 half sine waves and provides therefore a resolution of 10%.

The mode pin 3 on the device serves the dual purpose of allowing the time base to be varied thus increasing or decreasing the reaction time of the ZAX27™ but correspondingly reducing or increasing the resolution. For example, reducing the time base to half a second will increase the reaction time to half a second but this also reduces the resolution to 2% which is still good enough for most applications. If an application only needs a resolution of, say, 10%, the time base could be decreased to 100ms offering a faster reaction time.

The mode pin thus provides means for optimising the speed/resolution parameters for any given design if these matter. The time base can be varied between 100ms to 2.5s.

Figure 3a shows how the output drive capability of the ZAX27™ can be easily boosted. In this case the drive capability is limited only by the triac rating. The circuit shown for example will drive a 48kW load. Note that snubbering provision is not shown in any of the examples and some EMC suppression measure will also need to be taken depending on the load and topography of the construction.

The ZAX27™ is not restricted to driving single phase loads but can easily be configured also for multiphase loads. The illustrated example in Figure 3b is for a three phase application and it is obvious how this can be extended to other number of phases. Multiphase applications have particular advantages such as improved power delivery, frequency multiplication allowing smoother operation of machinery or lower smoothing requirements. It will be noticed in this example that there are three non-committed operational amplifiers which may be used to carry out other circuit control functions.

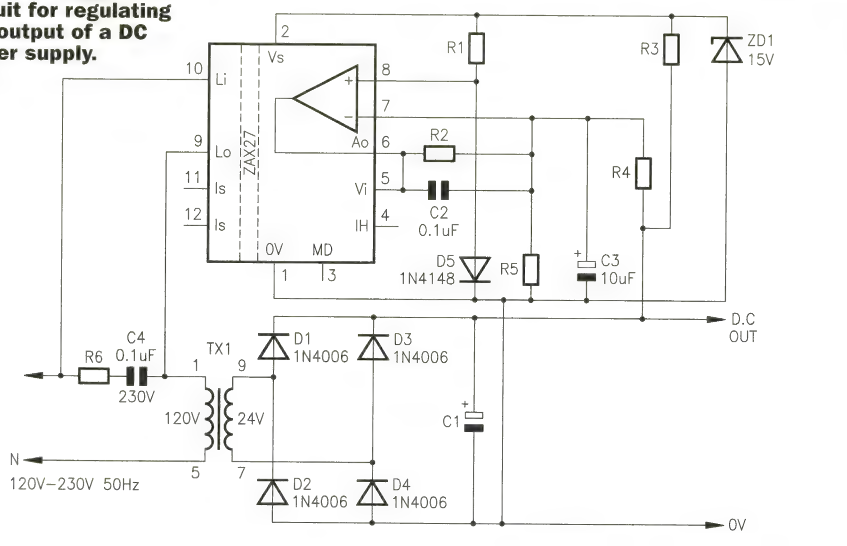
Figure 4 shows a typical closed loop application of the ZAX27™ (phase mode). The ZAX27™'s amplifier is used as an error amplifier to compare the reference set by R1,D5 with a sample of the output voltage. It then controls the supply to the transformer to maintain a constant output DC supply irrespective of load and mains supply variations.

As wide variations of mains supply is no problem the circuit is also suitable for automatic mains supply adjustment for appliances designed for global usage a feature only provided with expensive switch mode power supplies. Another advantage of this application is that it automatically compensates for transformer load regulation problems, an important consideration in the design of power supplies. When used as a pre-regulator at the front end of a linear supply, a very high efficiency linear supply can be realised whilst producing savings in reduced heatsink size and overall volume.

ZAX27™

The ZAX27™ is available from Maplin (Order As CK23A) £29.99 inc. VAT. EMI Filter ZFM23/2k5 (Order As CK24B) £11.99 inc. VAT.

Figure 4. Suggested circuit for regulating the output of a DC power supply.



COMMENT

by Keith Brindley

Penetration of satellite broadcast television services is still increasing at a phenomenal rate throughout Europe. While it has been unusual to see more than just a handful of satellite dish aerials on houses in the average British street, if numbers of installations continues at the present rate, it's going to be the norm rather than the exception shortly, to have a dish.

In the UK, where there are some 23 million television-viewing households, nearly 4 million of these households have a satellite dish. This is an almost one in five situation. Penetration is expected to increase, of course, over the coming months in the run-up to Christmas.

In Europe, the situation is similar, although only one country beats the UK's penetration, in both numbers and percentage. Germany has nearly 38 million television-viewing households, and an almost unbelievable 10 million of them have satellite dishes.

The remainder of European countries fall a long way short of the UK and Germany in satellite penetration, but the trends are apparent, and are expected to increase rapidly over the coming years. Over all of Europe, with 162 million television-viewing homes, there are 25 million homes with satellite dishes installed.

Some European countries indirectly lend themselves to satellite dish installation more than others. Mountainous regions, for example, benefit from satellite broadcasts more so than flat regions. Flat regions, too, usually benefit from easy installation of cable television systems which can alleviate the need of satellite broadcasts altogether. Also, different governments invest different amounts in technology and its facilities. So, the picture across the continent depends on physical geography and political geography, as much as any country's desire to have satellite television.

Most current satellite broadcasts are by pretty conventional means, and the future looks rosy for them as they are. On the other hand, the launches of Astra satellites 1E and 1F in October 1995 and April of this year (as well as the future launch of Astra satellite 1G next year) bode good for future forms of satellite broadcasting too. By next year, there'll be 56 digital transponders available for use by several hundred digital television broadcast channels. The wide choice is expected to create a market surge of customers who want satellite dish installations. Needless to say, the satellite industry is very excited over the digital prospects, and what the future holds for us all.

2001

I've looked at the problem in the past in *Electronics*, of course, but it's getting closer (the year 2000, that is) and the situation shows no sign of abating. For the few readers who aren't aware, I'm talking about what's going to happen to computers around the world which may be affected on 1st January 2000. It appears that many computers' in-built clock dates will revert back to 1900 and cause untold havoc to computer systems worldwide. To those of us with a computer built to handle the new millennium, this might all seem like a big joke, but (seriously) in fact, there is a Government sponsored agency (Taskforce 2000) which is advising UK companies on the matter.

And, as if computers themselves aren't enough, Taskforce 2000 has warned companies who manufacture goods with embedded microcontrollers in them (and let's face it, there are embedded microcontrollers in most electronically controlled appliances these days) that the new millennium could prove a difficult time for them too. Just imagine, your videocassette recorder, set to record the midnight striking of Big Ben on New Year's Eve 1999 could be the first time transporter, allowing you to record television programmes from as far back as the year 1900 – before television was even invented. Yes, I'm being facetious.

Actually, the problem is serious. It's estimated that some 80% of IT systems will be affected by the change of millennium. If yours, or your company's will be affected (you can check to see what happens to a computer simply by changing the date temporarily) and if you or your company rely on it for livelihood, then you need to do something about it. Certainly makes me glad I've an Apple Macintosh.

Surfing Blues

The public telephone network is being put under strain from Internet users who hang on the telephone line. Telephone networks were originally designed for voice calls of short duration. Typically, calls used to be of around three minutes, after which, users would get fed up of speaking and hang up. Internet users, on the other hand, tend to be on the telephone line for much longer than this (hours, if my telephone bills are anything to go by) for regular and frequent periods. Tying up a telephone line for such long periods ties up network resources and ultimately makes it harder for other calls to get through.

While this has placed minimal pressure on telephone networks to date, the sharp increase in Internet users (particularly the mass uptake which has started to occur in home users) will put ever more increasing demands on the telephone network. With every hour of an Internet connection taking up the equivalent of 20 average voice telephone calls, it's not hard to envisage the time (in the not-too-distant future) when the networks cease to be able to cope with any reliability. (This has probably already started to occur – the last time I tried to telephone for a BT engineer to report a fault the line was busy for several hours – yes, I'm being facetious, again).

In all seriousness, it means that significant expansion of worldwide networks has to take place immediately. Without planned, rapid expansion over the next few years, the busy signal will become an all too familiar sound.

DVD

It's been a while in the pipeline, but digital video disk (DVD) is about to come to fruition – at least, the hardware is. Matsushita is about to release the world's very first DVD player in Japan, and is expected to do the same by the end of the year in North America. Germany is next in the rollout, in February of next year. The UK isn't yet featured in the company's plans for product release.

Mind you, while the players are almost released, the actual disks are a seemingly long way off yet, which leaves DVD open to question. Players without disks are like CD-ROM drives without CD-ROMs, cars without petrol, bicycles without pedals, British weather without rain, televisions without pictures, and er . . . yes, you get the message – I'm being facetious, yet again.

The opinions expressed by the author are not necessarily those of the publisher or the editor.

PROJECT

Audio/Video MODULATOR

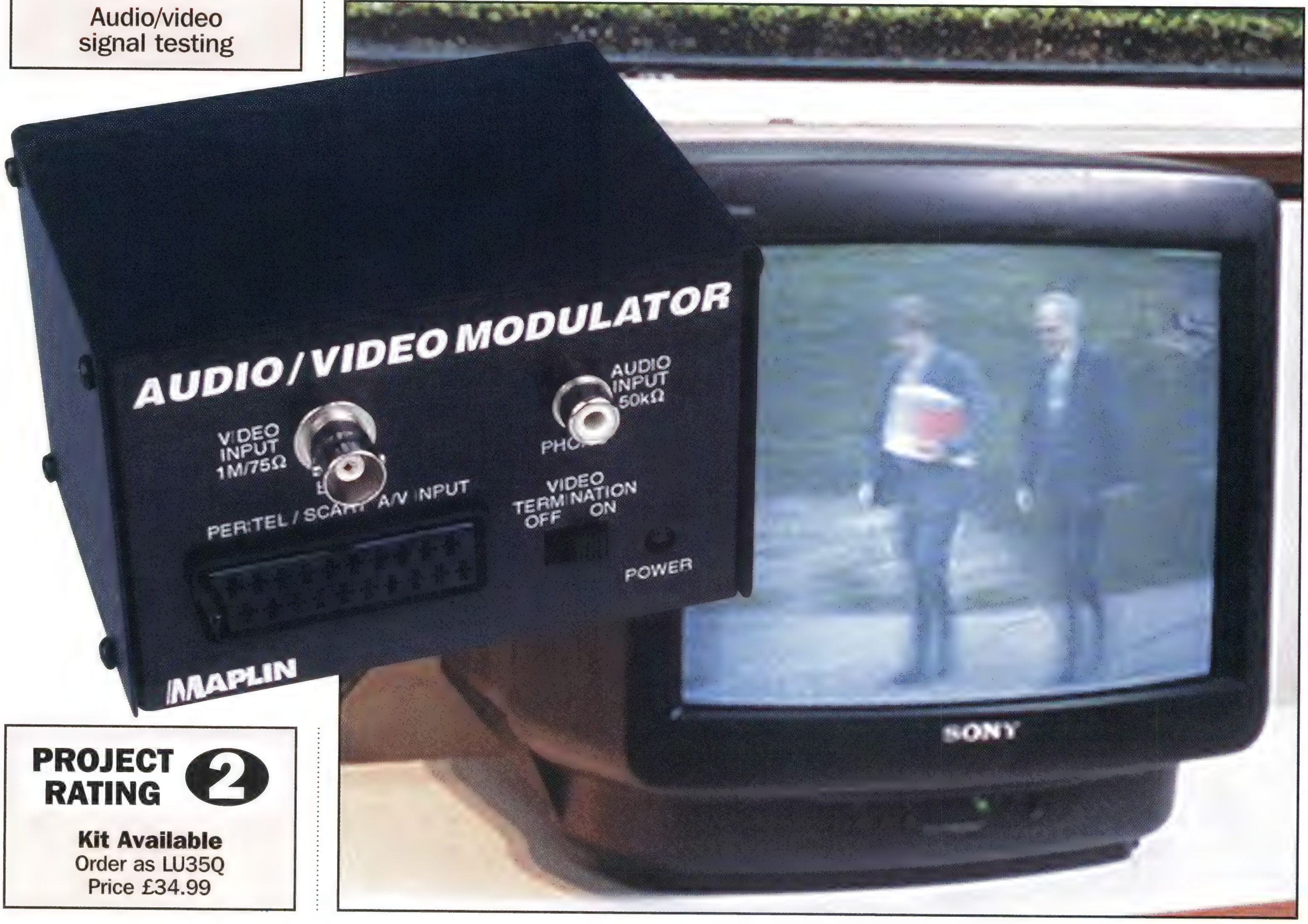
FEATURES

- Simple to build
- No alignment equipment required
- Colour or black and white
- SCART facility
- Pre-punched steel casing
- Test signal for receiver tuning

APPLICATIONS

- Camcorder replay
- Video editing
- Linking VCRs
- Audio/video signal testing

Design by Chris Barlow
Text by Chris Barlow and Maurice Hunt



PROJECT RATING 2

Kit Available
Order as LU35Q
Price £34.99

This project is a substantially revised version of the Audio and Video Modulator kit (LM79L), previously featured in the February 1989 issue (No.30) of Electronics. *The main reason for the update is due to the discontinuation of the originally specified UHF modulator (the UM1286), so the new circuit was designed around the recently introduced (and superior) 'Alps' modulator. This modulator features an integral 'aerial throughput' RF mixer/booster and a built-in test signal for receiver tuning, which causes a bar pattern to be displayed on a TV connected to the project, so that the picture can be adjusted for optimum results.*

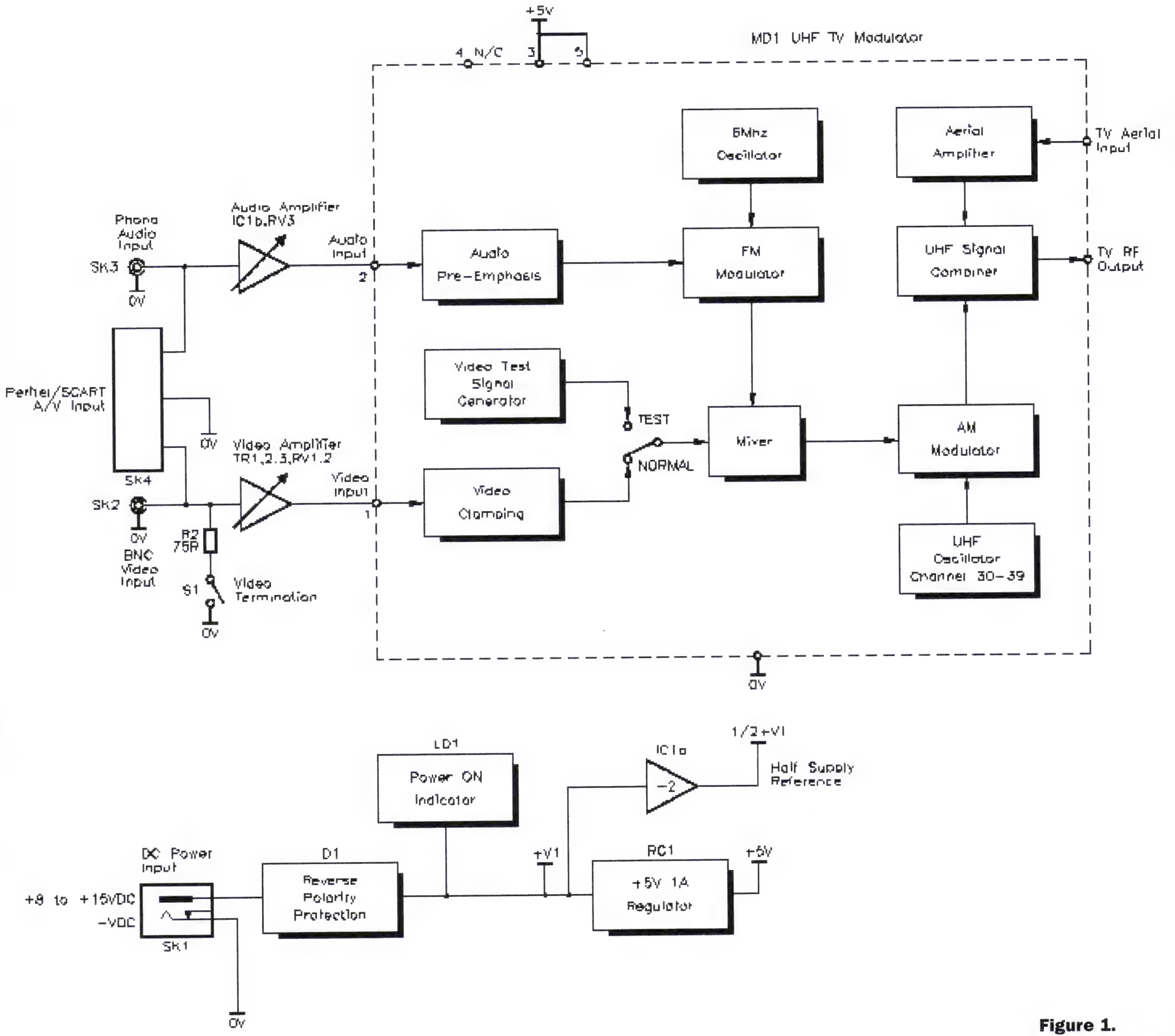


Figure 1.
Block diagram.

The opportunity was taken during the redevelopment process to add a number of useful extra features to the design, including a SCART socket and provision for adjustment to cater for the imminent Channel 5 introduction, while a pre-punched steel casing makes the project easier to construct.

Circuit Description

Refer to the block and circuit diagrams, shown in Figures 1 & 2, respectively. These should be of assistance when following the description.

The DC supply from the regulated AC-DC adaptor is applied to SK1, noting that the centre-pin is positive and the outer contact negative. D1 protects against reverse polarity damage to the circuit.

Low frequency decoupling of the supply is provided by capacitors C2 and C5, while C1, C3 & C4 take care of the high frequency decoupling. LED LD1 lights to confirm when power is applied. Voltage regulator RG1 provides a steady +5V level, which is required by the UHF modulator, MD1.

For the audio circuit to function correctly, a half +V1 supply reference is necessary, which is provided by half of IC1 (IC1a). The voltage reference applied to the input of this op-amp is derived from the two resistors R14 & R15, which form a potential divider. The op-amp is configured as a unity gain voltage follower to provide a low impedance half-supply, its input being decoupled by C13-16 and its output by C11 & C17-19.

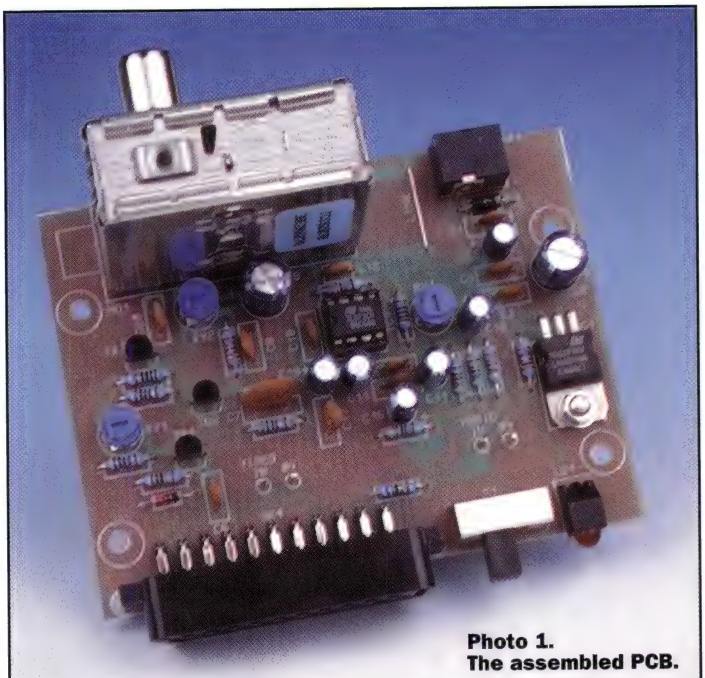


Photo 1.
The assembled PCB.

SPECIFICATION

Operating voltage:	8-15V DC (e.g. 12V 300mA AC-DC adaptor, YB23A)
DC power input connector:	2·5mm power socket, centre pin positive
Supply current:	144mA @ 12V
Audio input level:	150mV to 3V Pk-to-Pk
Audio input impedance:	50kΩ
Audio input connector:	Phono
Video input level:	200mV to 3V Pk-to-Pk
Video input impedance:	1MΩ approximately, 75Ω with termination load selected
Video input connector:	BNC
Audio/video connector:	SCART
RF TV output:	Channel 30-39 (543·25-615·25MHz)
FM sound sub-carrier:	6MHz
RF TV IN/OUT connectors:	Standard TV coax

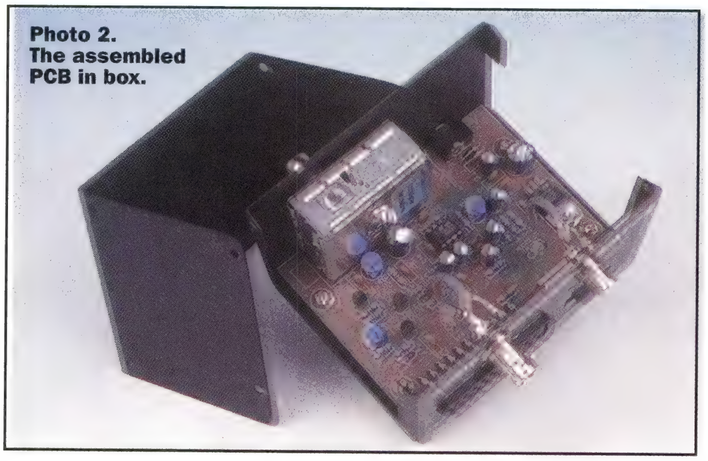


Photo 2. The assembled PCB in box.

The other half of IC1 (IC1b) is used as an audio amplifier which drives the sound input (pin 2) of the UHF modulator, MD1. Resistors R12 & R13 determine the gain of the op-amp, with potentiometer RV3 setting the level of audio signal applied to the amplifier's input. The incoming signal from pins 2 & 6 of SK4, or from the phono socket SK3, is AC coupled to RV3 via C10.

The video signal is applied to pin 20 of SK4 and its ground is connected to pin 18. The input impedance of the video amplifier, formed from transistors TR1-3, is approximately 1MΩ. However, this can be reduced to 75Ω by closing switch S1, which places a 75Ω resistor (R2) across the video input – this is known as a termination load.

The video signals are AC coupled via C6 into the gate of TR1, a Field Effect Transistor (FET). Diode D2 and resistor R3 are used to maintain the correct bias level. TR1 & TR2 form a broadband buffer amplifier, the gain of which is set by the value of the negative feedback resistor, R6 and potentiometer RV1. Resistor R4 provides the source load for TR1 and preset potentiometer RV2 forms the emitter load for TR3. The DC bias for TR2 is derived from R5 and TR1. A small amount of frequency compensation is provided by C7.

The video output from the amplifier is tapped off from the wiper of RV2 and fed to the video input (pin 1) of the UHF modulator, MD1. Inside MD1, the audio signal is converted into a 6MHz frequency modulated (FM) sub-carrier. It is then mixed with the video signal and fed to the amplitude modulated (AM) section, where the UHF carrier is combined to produce the final modulated RF output suitable for the aerial input of domestic TV sets.

PCB Construction

The PCB is a single-sided fibreglass type, with printed legend to assist assembly – refer to the PCB legend and track drawing, shown in Figure 3. The PCB has been designed for a minimum of off-board wiring, which is needed only to connect the video and audio sockets. The board is best assembled in order of ascending component size/height.

Start by fitting the four PCB pins in the position marked 'AUDIO'/'VIDEO' 'IN' & '0V'. Use the piece of 22swg wire supplied in the kit for the single wire link. Take care to ensure that polarised devices (electrolytic capacitors and semiconductors) are fitted the correct way round. Also, ensure that the IC socket for IC1 is fitted with its end notch aligning with the printed legend.

Fit the three preset potentiometers, and set them all to their half way positions; the circuit has been designed such that these settings should enable the unit to operate with a minimum of setting up being required.

The SCART socket (SK4) has two locating clips which are pushed through the holes in the PCB until they lock in place, then the socket pins can be soldered. Switch S1 has tabs at each corner of its metal body, which should all be soldered in to provide support. Fit the PCB-mounting LED LD1, and the power socket SK1 flush to the board.

The voltage regulator, RG1 leads must be pre-bent at 90° and the regulator heatsink tab fitted flat onto the board

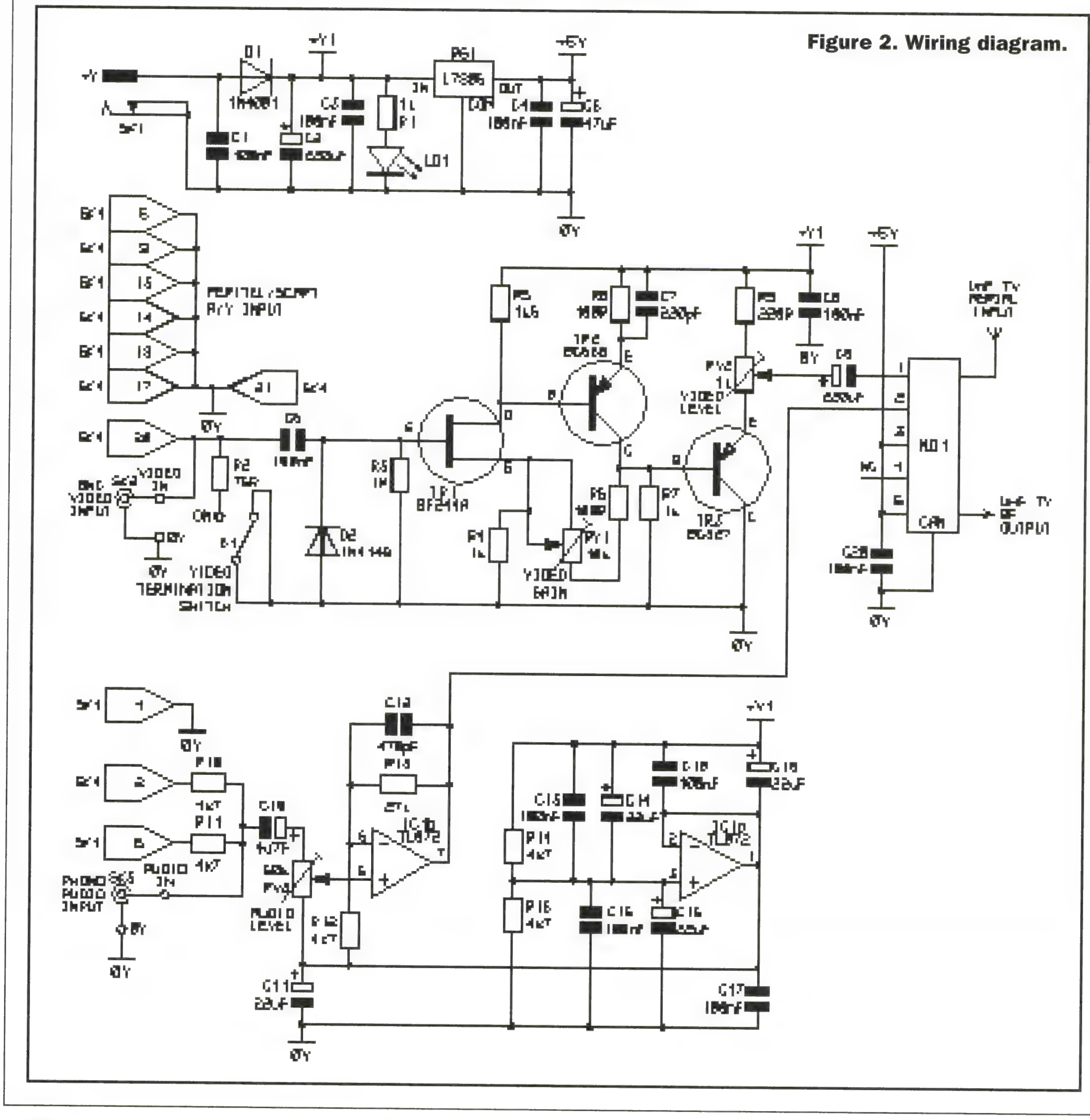


Figure 2. Wiring diagram.

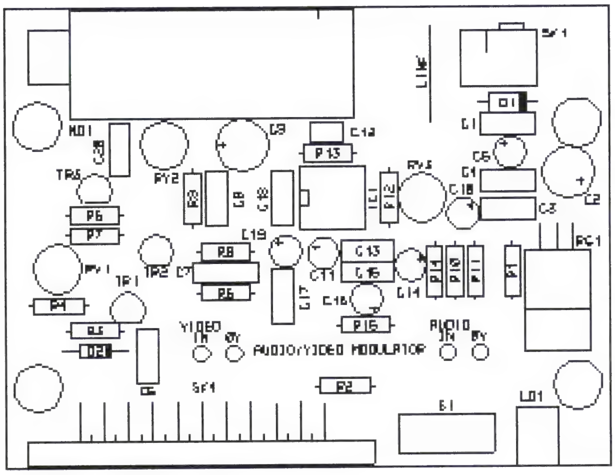


Figure 3. PCB legend and track.

using the M3 hardware supplied, as shown in Figure 4, the exploded assembly diagram.

The UHF modulator, MD1, is fitted vertically, with its corner tabs soldered in to provide support.

Install IC1 last of all, with its end notch aligning with that of the socket.

Having completed the board, check your work carefully for misplaced components, solder whiskers, bridges and dry joints, then clean off excess flux using a suitable solvent.

Testing

Testing of the completed board should be carried out prior to its installation into the casing, since faultfinding will then be easier, should it be required. Temporary connection to the board should be made, as shown in Figure 5. At this stage, the wires can be longer than required, as they are cut to size during the final assembly.

All the tests can be made with a minimum of equipment. You will require a multimeter, a UHF TV set and an audio/video source. A regulated 12V AC-DC adaptor, with centre-pin positive, will also be required to power the unit. Carefully lay the PCB assembly onto a non-conductive surface, such as dry paper or plastic.

The first test is to measure the resistance at the DC power socket, SK1. With the multimeter set to read ohms, connect its red (+) test lead to the centre terminal and the

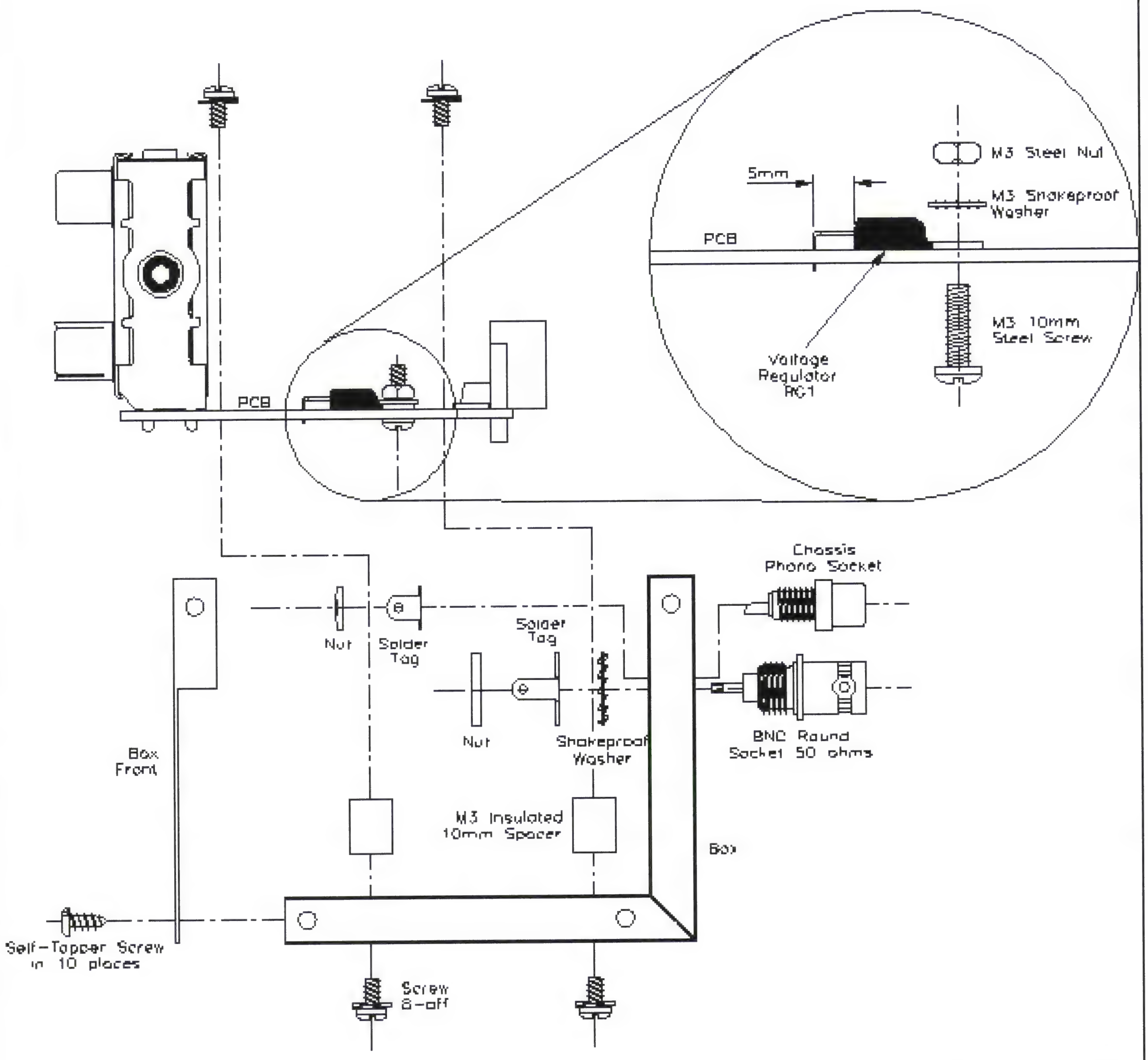


Figure 4. Exploded assembly.

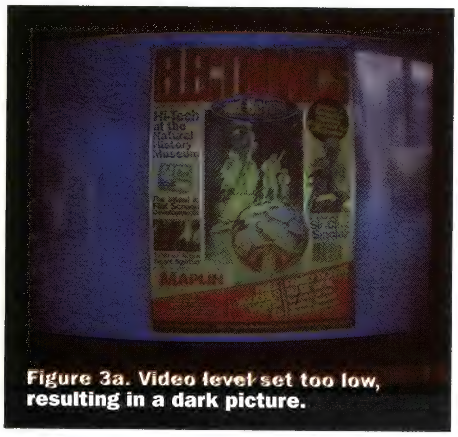


Figure 3a. Video level set too low, resulting in a dark picture.

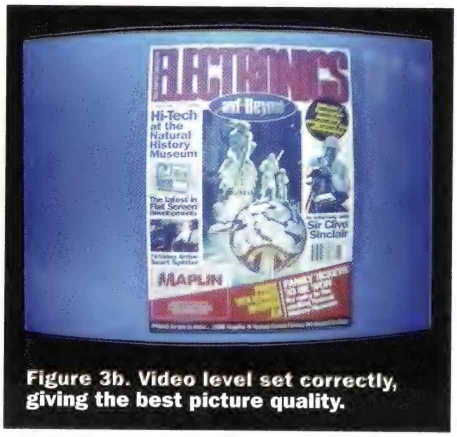


Figure 3b. Video level set correctly, giving the best picture quality.

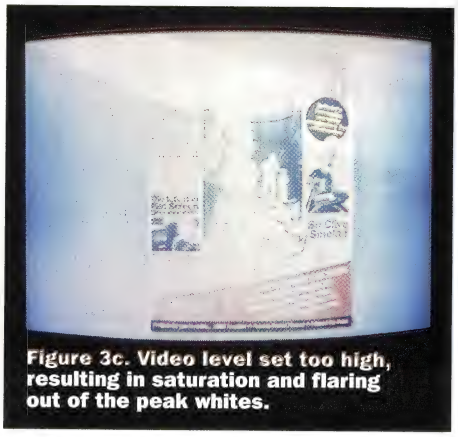


Figure 3c. Video level set too high, resulting in saturation and flaring out of the peak whites.

black (–) test lead to the power socket's side tag or any other 0V point on the unit (such as the UHF modulator casing). You should get a reading of approximately 1·5MΩ and, when the test leads are reversed, a much higher reading in excess of 20MΩ should be present, due to the reverse polarity protection diode D1.

Next, the 12V AC-DC adaptor should be switched on but not yet plugged into the onboard power socket, and the multimeter set on a DC current range that will accommodate up to 300mA. The aim is to test the current consumption of the unit in its quiescent state (no signal applied). The following process is a little fiddly in practice, and care must be taken not to short circuit the power supply.

The multimeter's red (+) test probe should be inserted into the power supply centre hole, the negative (–) test lead held on the DC power socket (SK1) centre pin, and the outer contact of the power supply plug must simultaneously be brought into contact with the tab (0V terminal) of the power socket. This can be achieved either (preferably) using a lead terminated in crocodile clips, by pressing the outer contact of the power supply plug onto the power socket tab, or onto the metal body of the UHF modulator. The 'power on' LED, LD1 should light and a current reading of around 144mA should be obtained.

If the current consumption is satisfactory, the power supply can be plugged directly into the power socket. The multimeter should then be set to read DC volts (up to 20V). With the negative (black) test lead attached to a convenient 0V point on the board (e.g. the modulator body), voltages on the board should approximately match the following:

Cathode of diode D1 = +11·2V DC
Link = +5V DC
Pin 1 of IC1 = +5·6V DC
Pin 7 of IC1 = +5·6V DC

This completes the DC testing of the audio/video modulator, and the multimeter can now be put aside.

Next, connect a coax lead (GW61R) from the RF output of the modulator to the aerial input of a UHF television. With the UHF modulator's test switch 'on' (upper position), tune a spare channel on the TV to approximately 36, where you should see a screen with two vertical white bars on a black background, with no sound. Connect an audio/video signal to the input (BNC/phono or SCART) of the modulator. If no other video connection is made to the unit then the termination switch (S1) must be on.

To set the audio level, adjust potentiometer RV3 until the sound level is the same as for an off air transmission (BBC, ITV, CH4/5). Next, set RV1 fully anticlockwise and RV2 to its halfway position, so that peak whites don't flare out and produce excessive buzzing on the sound channel. The final setting of the video level is down to your personal preference – see Photos 3a-c. DO NOT make any attempts to adjust any of the presets inside the UHF modulator (MD1), as these are factory set using sophisticated test equipment.

Final Assembly

The unit is housed in a pre-punched screened metal casing for ease of construction. Fit the 10mm threaded insulated spacers to the holes in the PCB, and carefully install the PCB into the casing – see Figure 4, showing the exploded assembly diagram.

Install the BNC and phono sockets into their holes in the casing and secure them with the nuts and washers supplied with the sockets. Connect the sockets to the audio and video input PCB pins using short lengths of suitable screened cable (the outer screen connects to the 0V terminal in each case) – refer to Figure 5, showing the internal wiring required.

Finally, fit the lid onto the casing with the screws supplied, and stick on the four rubber feet on the box underside.

Using the Modulator

Refer to Figure 6, showing the general application wiring between the unit and various pieces of video equipment that can be used with it. The test switch on the modulator can be switched in to assist the tuning in of a different TV set to match the modulator if the system setup is altered.

Note on Tuning for Channel 5

When the new Channel 5 is introduced, the UHF modulator may need to be tuned for a different frequency, away from the existing channel 36 and towards channel 39. This can be achieved by adjusting the channel frequency preset control – see Figure 6.

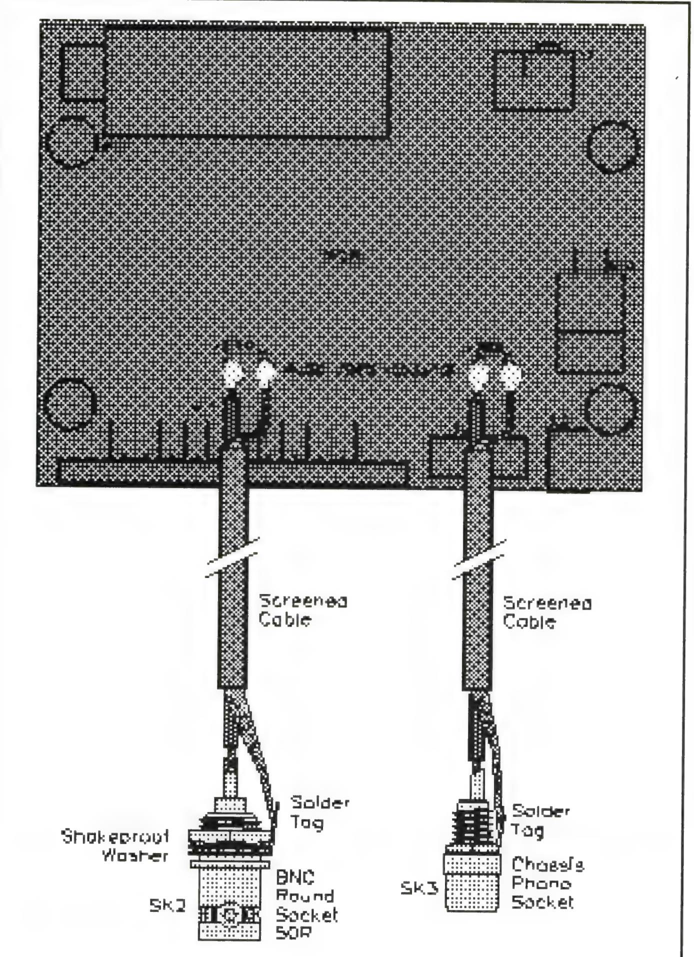


Figure 5. Internal wiring.

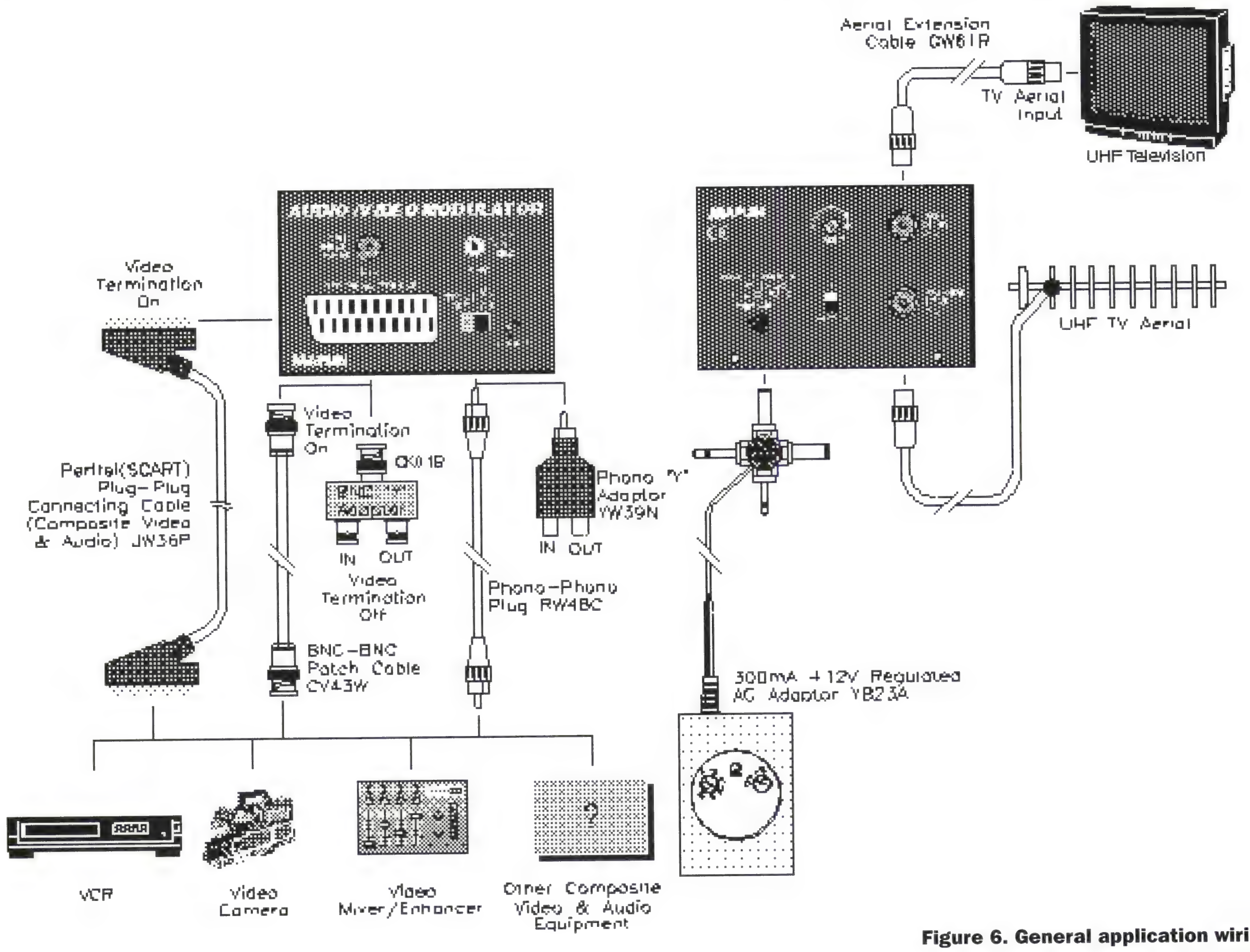


Figure 6. General application wiring.

PROJECT PARTS LIST

RESISTORS (All 0·6W 1% Metal Film, Unless Stated)

R1,4,7	1kΩ	3	(M1K)
R2	75Ω	1	(M75R)
R3	1MΩ	1	(M1M)
R5	1k5Ω	1	(M1K5)
R6,8	100Ω	2	(M100R)
R9	220Ω	1	(M220R)
R10-15	4k7Ω	5	(M4K7)
R13	27kΩ	1	(M27K)
RV1	10kΩ Preset Potentiometer	1	(WR42V)
RV2	1kΩ Preset Potentiometer	1	(WR40T)
RV3	50kΩ Preset Potentiometer	1	(WR43W)

CAPACITORS

C1,3,4,6, 8,13,15, 17,18,20	100nF 16V Ceramic Disc	10	(YR75S)
C2,9	200μF 16V Radial Electrolytic	2	(AT41U)
C5	47μF 16V Radial Electrolytic	1	(AT39N)
C7	200pF Ceramic Disc	1	(WX60Q)
C10	4μ7F 63V Radial Electrolytic	1	(AT76H)
C11,14, 16,19	22μF 16V Radial Electrolytic	4	(AT37S)
C12	470pF Ceramic Disc	1	(WX64U)

SEMICONDUCTORS

D1	1N4001	1	(QL73Q)
D2	1N4148	1	(QL80B)
RG1	L7805CV	1	(QL31J)
LD1	PCB-mounted Red LED	1	(QY86T)
TR1	BF244A	1	(QF16S)
TR2	BC559	1	(QQ18U)
TR3	BC327	1	(QB66W)
IC1	TL072CN	1	(RA68Y)

MISCELLANEOUS

SK1	PCB-mounted 2·5mm DC Power Socket	1	(FK06G)
SK2	BNC Round Socket 50Ω	1	(HH18U)
SK4	Peritel Right-angled Socket (Lugless)	1	(BP65V)
SK3	Chassis-mounted Phono Socket	1	(YW06G)
S1	Right-angled SPDT Slide Switch	1	(FV01B)
MD1	6MHz UHF Modulator	1	(WC21X)
	8-pin DIL Socket	1	(BL17T)
	1mm Single-ended PCB Pin	1 Pkt	(FL24B)
	M3 10mm Insulated Spacer	1 Pkt	(FS36P)
	M3 10mm Steel Screw	1 Pkt	(JY22Y)
	M3 Steel Nut	1 Pkt	(JD61R)
	M3 Shakeproof Washer	1 Pkt	(BF44X)
	0·71mm 22swg Tinned Copper Wire	1 reel	(BL14Q)
	Miniature Coax Cable	1m	(XR88V)
	Stick-On Feet Domed	1 Pkt	(BP59N)
	Box	1	(BL98G)
	PCB	1	(GJ59P)
	Instruction Leaflet	1	(XZ10L)
	Constructors' Guide	1	(XH79L)

OPTIONAL (Not in Kit)

300mA AC Adaptor Regulated	1	(YB23A)
Aerial Extension Cable	1	(GW61R)
Peritel Audio & Composite Video Plug to Plug	1	(JW36P)
10Base2 BNC to BNC Patch Cable 2m	As Req.	(CV43W)
BNC Y Adaptor	1	(CK01B)
Single Phono-Phono Plug	As Req.	(RW48C)
2-to-1 Phono Adaptor	1	(YW39N)

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.
The above items (excluding Optional) are available as a kit.
Order As LU35Q (Audio/Video Modulator) Price £34.99

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

The following new items (which are included in the kit) are also available separately, but are not shown in the 1996/97 Maplin Catalogue.
Audio/Video Modulator PCB **Order As GJ59P Price £3.49**
Audio/Video Modulator Box **Order As BL98G Price £11.99**

Radio Cracker

COMMUNITY RADIO

In 1991 the Charity 'Christmas Cracker' launched their community radio stations – 'Radio Cracker' to raise public awareness of third world issues, and generate funds for relief and development work. In 1992 a group of volunteers from Ballymena in Northern Ireland joined the project, and became one of the most successful stations that year.

They were among a handful of stations who returned to the airwaves in 1993, and once again had a runaway success, raising well over £17,000 for the second year in succession. Fuelled by this success they went on in 1994 and in 1995 raised an astounding £38,000!

Brian Adams, their Technical Manager in 1993, explains how Radio Cracker Ballymena went 'On The Air'......

Initially, a number of people who were interested in the work of Christmas Cracker arranged a public meeting, to determine whether or not there was sufficient interest to establish a radio station. As a result of that meeting, a management committee was set up, who with the help of the national charity were to organise Radio Cracker Ballymena. National support was to include training documentation, nationally organised advertising, supply of transmission equipment, 'jingles' and station idents on CD, and a news service by satellite.

The national co-ordinating team also organised all of the official paperwork with bodies such as the radio authority, taking away this burden of responsibility from the local bodies. In 1993 all that was to change – the Christmas Cracker organisation decided to stop radio stations, because of the danger of the charity becoming known just for radio. They had however, allowed local groups who in 1992 raised over £15,000, to retain their transmission equipment, and gave permission for any group who had already ran a station to do so again in 1993 – but without national support. Following their success in 1992, the Ballymena Committee felt that they had no choice but to return again in 1993 – no matter what the obstacles. With what experience they had gained they set about the task! Their persistence was rewarded – with no national support, and broadcasting for a shorter period of time, they managed to raise over £22,000. In 1994 they continued, raising £24,000. In 1995 the mayor of Ballymena challenged the people of the town to break the UK record for a Radio Cracker station – held until then by Wimbledon at £25,000. They were not content just to break the record – they demolished it, raising over £38,000 in the four week period!

Committee

The committee were perhaps the most unlikely lot ever to come together to do anything! The youngest members were teenagers, the oldest in their forties. With the one exception of a BBC Audio Assistant, none had any experience of radio work worth considering. There were people from various backgrounds – a social worker, a car mechanic, a computer technician, DJ's, students, salesmen, a lighting engineer – all of the wrong people for radio.

What they lacked in experience, they made up for in enthusiasm, and pure determination to make the project work. They quickly realised the importance of harnessing the local young people to work for the charity, and so established a youth committee, made up of student representatives from the local schools. The youth committee enlisted the help of friends in their schools to organise 'Cracker Events' and competitions, and later helped to staff the station.

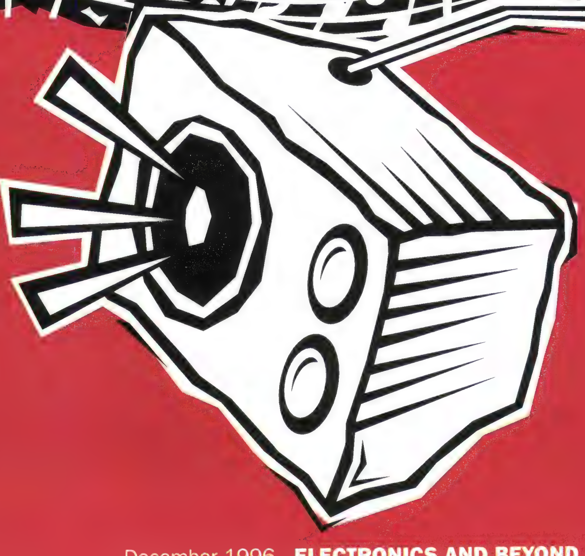
Premises

It quickly became apparent that finding premises was top of the agenda if the station was ever to get off the ground. Because national headquarters had to collate information from many stations to pass on to the radio authority, they needed to know months in advance of broadcasting where both studios and transmitters were to be located. This created an immense problem – with high profile being important, it was felt necessary for the station to be located in the town centre – but how do you have someone commit prime retail space to a charity for over a month, and get the commitment months in advance of needing it?

The manager of the towns new shopping centre came to the rescue. Being new, he was quite sure that he would have empty units at Christmas, and even though he could not be sure of an exact location, he could promise that space would be available somewhere in the centre. This did not only resolve the problem of an address – being within a shopping centre had many other advantages, such as 24 hour security, and readily available services. It also promised a ready made audience of tens of thousands of shoppers passing the station premises every week!

Fund Raisers

Community radio stations must be licensed, just like any other radio station, and even for a low power transmitter, this can be quite expensive – the 1W FM transmitter used by Radio Cracker costs over £1,000 to license



for a month! There are fees which must be paid to other bodies, and although registered charities receive substantial discounts in many cases, there is a considerable amount of money needed before the station can go on air. In order to raise this start up money, and also to raise the public profile of the project, a number of fund raisers were organised. Some were quite common – a fashion show, and a wordsearch quiz for example. Others were a little more imaginative – a 'Shanty Town House' made of old wood and cardboard was built inside the Fairhill shopping centre, and advertised with the slogan "The alternative Ideal Home Exhibition – see how the other two thirds live!" A cake, measuring approximately five feet by three, was baked by local school pupils, and iced in the form of the radio cracker logo – it was sold in slices, as 'Crackers massive cake sale!' The fund raisers in 1992 just about met the setting up costs, and paying the fees.

Legal Obligations

Legal obligations as already highlighted, there are certain obligations to be met in establishing a radio station. The license fee is one expense, and the radio authority have strict guidelines which must be adhered to by the station organisers. These cover areas such as maximum radiated power, aerial height, broadcasting hours, and codes of conduct for material broadcast, including detailed regulations regarding advertising.

There are a number of other bodies who must be satisfied if music is to be broadcast, and in the case of Radio Cracker, music formed a major element of the station output. The Mechanical Copyright Protection Society are responsible for licensing their members work for re-recording - including the use of music to make up jingles and advertisements. Performing Rights Society govern the actual performance of their members work, whether that be in the form of live music or pre recorded material such as records and CD's. Phonographic Performance Limited look after the use of recorded works in any performance situation, including public broadcasts.

The requirements of all of these bodies must be satisfied in advance of going on air. There is also an obligation to the general public, and to that end, public liability insurance is a necessity. Although dealing with so many authoritative bodies may seem a daunting task to the amateur, it was found that in practise, they were very helpful in advising the station of the legal requirements, and most of the paperwork involved was very straightforward, and easily filled in.

PR!

There is little point in running a radio station if the public don't know it is there! Eventually people will find it when scanning the dial for something else, but ideally, they should be waiting with a sense of expectancy for the new station to begin transmissions. The fund raising promotions certainly helped to raise public awareness, but more was necessary. Information was sent regularly to the local press, and a well known local personality – a presenter on Ulster Television – was asked to perform the official opening. Even with all of this, it was felt that the publicity in 1992 was not all that it could have been, so in 1993 some improvements were made. Instead of just sending facts to the press, complete stories were written, and these were accompanied by photographs. This means of obtaining free publicity was continued in subsequent years to great effect. A special event which gave considerable publicity, was participating in the national charity organised 'Alternative Christmas' held on the 25th of June 1993. The Radio Cracker roadshow was set up in the town centre, and DJs dressed as Santa, and various other guises, played Christmas music from a stage decorated with tinsel and a Christmas tree! Way-out events such as this were great crowd-pullers, and of course generated more of that vital press coverage.

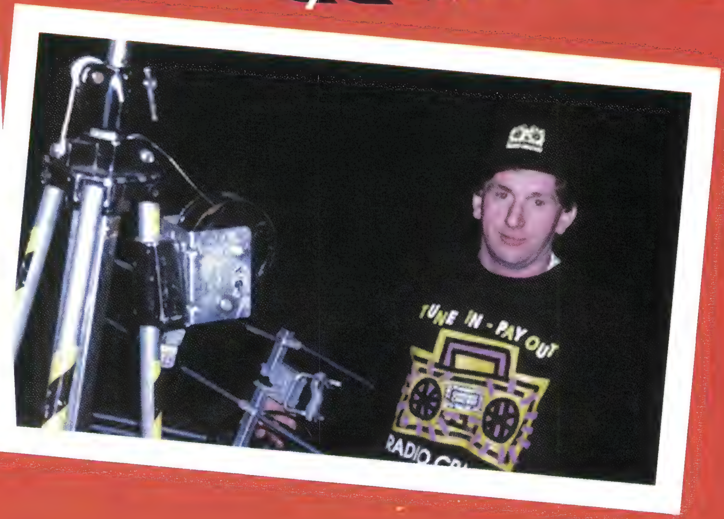
Program Sources

It was always the intention that as much program material as possible would be locally produced. But some things are best left to the experts, and one of the prime examples of this is news. The organisers were well aware of the importance of news to the station, but knew too that they simply did not have the resources to produce it locally. In 1992, the national news was provided by satellite in a special arrangement with Sky News. National Christmas Cracker then added their own bulletin at the end of the satellite news, and this at certain times was supplemented by local bulletins. In 1993, there was no such service available. A begging letter to BBC Radio Ulster resolved the problem – Radio Ulster gave permission to re-transmit their bulletins. The BBC helped out in more ways than one – Radio 1 FM was used as an overnight sustaining service – when Radio Cracker closed down at 11 pm at night, the presenter simply announced that Radio Cracker, by permission of the BBC, was joining Radio 1 FM. Apart from these two services, virtually all of the material originated from Radio Crackers own studio, except for a few pre-recorded programs, and interviews, which were edited off-site, and brought in on either DAT or ¼in. tape.

The Studio

In 1992 the shop unit used was quite large, and there was sufficient space to build two studios, as well as a control room. In practise it turned out that Studio 2, which was not as well equipped as Studio 1, was used only for recording adverts, interviews and voice overs, and the occasional news bulletin. In 1993 space was at a premium, since a Crackerteria cafe was being run alongside the radio station, so Studio 2 was dispensed with. Adverts and voice overs were recorded using the main control room desk, with the kitchen acting as a booth!

In addition to the actual studios, space was set aside for a reception area, storage, and a preparation area, with desks and facilities for staff to make tea and coffee. The walls dividing these areas were made of plywood sheeting, screwed to softwood framing, simply because the plywood sheets could be sold at the end of the project. The studio and continuity room walls were made as conventional stud walls, with a single sheet of plasterboard on each side. In 1993, two walls of Studio 1 were covered in carpet to improve the acoustics and the appearance. No multi-layer walls resting on Neoprene here – remember this is radio, where generally only one microphone is on at any point in time, the user will be very close to it, and will quite possibly be speaking over music which will at least partly mask any extraneous



noise. In practise, some noise from reception and other areas was audible on the studio mics, but not to the extent where it was very noticeable, and no real sound proofing was necessary. The materials to construct the stud walls were donated by a builders merchant in exchange for advertising on the station, and the studios for 1992 were dismantled carefully, allowing most of the timber and plasterboard to be re-used in 1993. In addition, a glazer donated glass for a double glazed window onto the shopping centre mall in 1993, because the unit used had no existing walls or windows. Another change in '93 was the acoustic treatment of the studio. The unit had a suspended ceiling, so tiles were removed and stud walls built through to the real ceiling. The walls were simply painted, but to reduce reverberation in the studio, a large screen was constructed of fibreglass wadding and cloth, and this structure strategically placed. Despite its simplicity, it made an amazing difference to the characteristic of the sound in the studio.

Disaster Looms!

In 1994 the organisers faced a prospective disaster – all of the units in the shopping centre were full! The centre management were keen to help Cracker out, and came up with a novel solution. A number of artificial bridges crossed the mall of the centre, masking some steelwork which had been installed to facilitate future first floor development. With the assistance of a number of tradesmen, a complete studio was built on one of these bridges and aptly nicknamed 'The Bridge of Hope'. A shop, and location for special broadcasts, was built near the bridge in the mall below, complete with telephone, power, and audio links between the two!

Studio Setup

The studio equipment has been basically the same for 5 years, but in 1993, the physical layout was vastly improved over that in 1992. The equipment was arranged as shown in the diagram, with the mixing desk centrally in front of the presenter, with gram decks either side, and cassette decks and CD players to left and right of centre on an elevated section above the desk. This platform also held a cartridge player, and a third CD player for playing pre-recorded jingles etc. Opposite the presenter, there was sufficient space for two permanently set up microphones for guests or co-presenters. The desk was a Yamaha 1602 – 16 channels into stereo outputs. It was not ideal for the job, but with a little ingenuity was made to suffice. A problem which was encountered in 1992 was that presenters continuously turned up gain controls, but never turned them down, with the result that the desk output every now and then reached the point of distortion! A quick experiment revealed that this was partly a psychological problem - the idea of having gain controls fully anti-clockwise seemed to give the impression that the channel volume was too low – but for CD players, with their high output levels, this was what was needed to make them balance correctly with microphones, which even when used close up, had comparatively very little output.

The problem was resolved by placing 20dB pads in the insert points of the channels which had the CD players – this meant that for the same level as before, the gain controls were positioned at 10 – 11 o'clock on there scale. With this illusion of gain, and 'gaffa-tape' over the VU meters, the self-professed experts stopped tweaking gains, and the problem was resolved.

Technics gram decks were used in all but the last year, which with their fast startup time, and high reliability, proved more than adequate for the job. The CD players were Sony domestic models, which although not designed for studio use, worked flawlessly, and even after three weeks, were showing no signs of abuse.

Initially SM58 microphones were used throughout – mainly due to the fact that they were sure to survive three weeks of abuse and misuse by amateurs. It was found in practise though, that there was a noticeable drop in volume if the presenter moved to either side of the microphone, which occurred quite regularly if he was starting record decks. The presenters 58 was replaced by a Beyer, fitted with a foam windshield, which gave very acceptable results.

Monitoring in the studio was accomplished using Beyer DT100 headphones supplied from the desk output via a 6 way splitter, and a Toa T150 Fashion Speaker mounted on the wall opposite the presenter, in later years being replaced by bookshelf hi-fi speakers. This was powered using a domestic Hi-Fi amp located in 'continuity'. It was fed from the right main output of the desk, the left being taken as 'Studio Output'.

The 'Studio Output' control was taped down, and tape was placed across the track of the right fader, or 'Monitor' level control. This guaranteed that even if presenters forgot to turn down the monitor speaker when microphones where turned up, at least they could not reach feedback levels.

Pre-fading was only available on headphones – quite a good idea where amateurs are involved. To listen to studio output, the presenter just pre-fade listened to the main stereo outputs. (By now you should have figured out that the station operated in mono!)

'Talkback' was achieved by bringing a line input from the continuity desk into channel sixteen of the studio desk, and permanently taping down the PFL button. This ensured that no matter what the presenter was listening to on phones, he or she could be spoken to from the control room. The talkback circuit was also used as a clean feed of station output - everything except the studio, to enable presenters to merge smoothly with other sources, such as tape playback of adverts, or news from the tuner.

The only other equipment in the studio was a TV and video recorder, used for teletext reception (great for up to the minute news, and trivia facts!), and for playing Karaoke videos! Continuity Although the studio was the main source of station output, it was not nearly as well equipped as the continuity room.

The technical operators in continuity were responsible for playing adverts, and other pre-recorded material, and bringing in the news and Radio 1 FM at the appropriate times. It was also possible to play in music and tapes for inexperienced presenters, and even bring up the presenters microphone remotely! Station output level was controlled by continuity, and the transmitted signal was also recorded, to comply with the license

conditions. Sound level in the Crackerteria, and on the mall were controlled from here.

Since reel to reel tape machines were scarce, adverts were recorded through the continuity desk, using the internal phone system to cue voice over artists in the kitchen! The other functions of continuity were putting phone calls on air, and mixing live sources from the shopping centre mall. The continuity desk was a 24 channel Soundcraft 200 SR (a 16 channel Allen & Heath in 1992). Station output was taken from group fader 1, and continuity monitor from group fader 2. Group fader 3 was taken as output to one of the reel to reel machines, and group 4 and the stereo output were not used.

Since the group select buttons on the 200SR are either groups ½ or ¾, a source could be connected either to station output, or to record output. Channel 24 on the desk was used for the talkback microphone. It was selected to groups ¾, but panned hard right, to ensure that it never went to station output, even if the group select button was accidentally pressed. Auxiliary 3 – a post fade auxiliary – was used as the talkback output, so to talk to the studio, channel 24 fader was used. (A press to talk button would have been nice, but beggars can't be choosers!)

Auxiliary 4, the other post fade auxiliary, was used as the clean feed to the telephone balance unit, which received everything except itself. Auxiliaries 1 and 2 were occasionally used to send pre fade signals to reverb and delay, both of which were returned to channels on the desk. In 1994 and 1995 continuity desks with 'Matrix' outputs were employed – which made control over the various output circuits much easier. Two CD players and a cassette deck, both domestic units, and a Sony DAT machine were located to one side of the desk, along with a Pioneer A300 Hi-fi amp, which powered the local monitors. One of these, as already mentioned, was fed from the group 2 output of the desk. The other was driven from the desk headphone output, effectively making it a cue monitor. A Sony Tuner was used to receive Radio 1, and Radio Ulster.

Two Studer ¼in. half track machines completed the complement of signal sources. These were located directly behind the technical operator, so that he could operate them, and still keep one hand on the desk, to operate faders. In 1995 the reel to reel machines finally were dispensed with, at least during the transmission period. Jingles and adverts were all recorded in advance, edited onto DAT, and then transferred to CD's which effectively made the reel to reel machines redundant. Other continuity equipment included two hi-fi amps, to drive the speakers on the mall and in the Crackerteria (more Toa Fashion Speakers), the telephone balance unit, two telephone extensions, and a 19in. rack housing two Panasonic Super VHS video recorders, which were used, running at half speed, as logger machines, giving six hours logging on standard VHS tapes.

Transmission

As mentioned earlier, a 1W transmitter was used. For community radio, more power is not really needed in most areas. What is much more important is aerial location. One of the conditions of the community radio license is that the top of the aerial be no more than 10m above ground level (this was increased in 1995 to 20m). Now in a built up town centre, this could easily mean being well below the tops of nearby buildings. Fortunately, the Fairhill shopping centre is located at almost the highest point in Ballymena, and is only a two story building. A local electrical company who own a hoist, erected the mast, which held the transmission aerial, the FM reception aerial, and the television aerial. The reception aerial was located as near as was possible, vertically below the transmission aerial, to minimise the effect of the relatively high power signal being radiated from it, which could easily have swamped the received signals from the distant BBC transmitters. In 1995, a new aerial joined the array – a receiving aerial for the Outside Broadcast unit.

It is certainly worth experimenting with aerial location if transmissions are not what they could be – the Radio Cracker aerial for 1993 was moved approximately 20m to a different part of the building from its site in 1992. This made a considerable difference to the coverage area. Good reception was obtained over a three mile radius, but in areas of high ground, with a good line-of-site to the town, acceptable results were obtained five or six miles away from the transmitter. One person even picked it up on a car radio 15 miles away.

Radio Cracker broadcast from 7:00am each morning until 11:00pm each night, with Radio 1 FM filling in the overnight period. News bulletins were taken 'on the hour', which was quite convenient, since Radio Ulsters bulletins usually begin with 'pips', making the switch over quite easy for the technical operator in continuity.

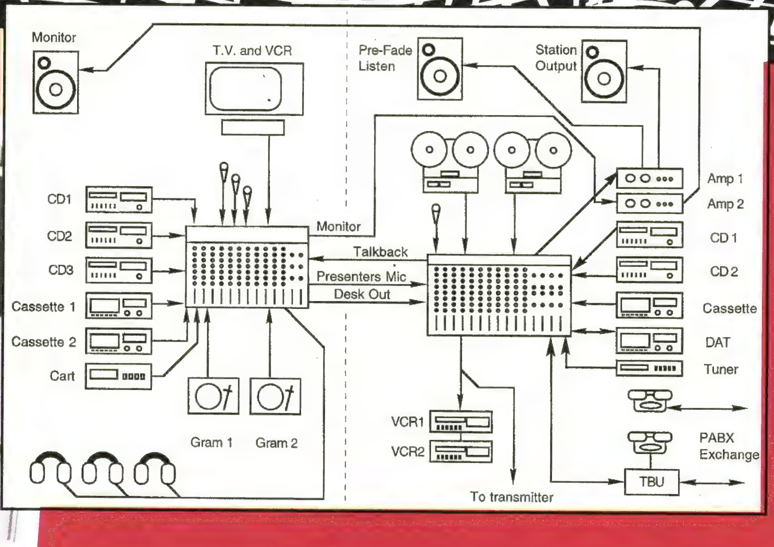
Being located in the town centre ensured that shops and office premises were able to achieve good reception, and as a result there was a large audience amongst the business community.

On The Air

Generally speaking, the station operated very smoothly. The 1993 studio was completed only two days before going on air, allowing very little time for presenters to rehearse their shows and get used to the setup. Some people ended up going on air, never having been in the studio at all before their first show! The studio desk gains were initially set up so that the correct levels were obtained when the channel faders were full open. Although in recording or PA circles, it is preferred to operate at some setting below maximum, often marked on the desk as a nominal, or 0dB position, in a radio setup, full fader travel is easier to cope with.

Presenters, especially inexperienced ones, find it much easier to push a fader full open, than to move it to a specific position, especially if they are ducking music for voice overs.

Equalisation was set flat for most channels – the notable exception being those for the gram decks. The actual eq for these was far from being true RIAA, but the three band eq with semi-parametric mid allowed for sufficient adjustment to achieve reasonable results. (Most Hi-fi purists would tear their hair out, but then they are unlikely to be listening to a mono FM radio station playing chart music anyhow!) Most presenters used CD's in any case, so gram deck eq was not really a big issue.



Many presenters ran 'phone in' competitions, taking the answers 'on air'. This was quite easy to achieve. An old telephone balance unit had been borrowed, and this was connected to the continuity desk as described above. When a call was directed to continuity from reception, the operator in continuity simply pressed the divert button on the balance unit, and replaced his handset.

At this point, the caller could hear station output, and the operator could speak to him or her using the talkback mic on aux 4. The caller could be pre-faded on the monitor speaker, allowing the operator and caller to converse until the presenter was ready to take the call. At that point, the phone was simply faded up on the continuity desk, allowing the presenter to hear via the talkback circuit. The continuity talkback mic was of course still active, and it was not unknown for staff in continuity to give clues to the callers, without this being heard on air!

Until 1995 and the use of CD's, adverts were kept on a single spool of $^1/_4$in. tape, each being separated from the next by a section of leader tape, on which was written the advert name and number. A list was available giving the advert numbers, and the time into the tape at which it could be found. It was a relatively easy task then to find a particular advert by looking up its time on the list, and spooling the tape through to this position. The Studer machines are very fast at starting, so adverts could be played almost instantly on cue. The second Studer was generally loaded with a tape containing trailers, or short pieces of information about Christmas Cracker, varying in length from about 10 to 30s. These were played between adverts to allow the operator time to cue the next advert on the reel.

Adverts were made by directing one of the CD players to groups $^3/_4$, and mixing the music with the mic in the kitchen. The internal phone system was used as a low-grade talkback circuit to the kitchen, and the mix was monitored in continuity by pre-fade listening to group 3 output.

Station output was taken to a number of destinations, for example, the Crackerteria speakers, the transmitter, and the logging machine. This was achieved by using high quality transformer splitters connected to Group 1 output from the desk.

The studio output was compressed using an Alesis compressor, set for just over 2:1 compression, with a soft knee characteristic. The second channel of this was used as a hard knee limiter, inserted in the group 1 output, to ensure that the input to the transmitter was not overloaded.

A number of primary schools sent small groups of singers and musicians to perform live on air, and a number of other musical events in the mall were broadcast live. For this purpose, mic points had been wired on the front wall of the studio, connected back to the Soundcraft desk in continuity. Most small groups were covered using AKG 451's with either CK1 or CK8 capsules, and a mixture of SM58's and Beyer microphones.

Interviews with passers by, and other victims, were accomplished using a Sennheiser radio mic, which performed very impressively, even a long distance away from the studio. The interviewer listened to the station output on a Walkman style FM radio! A number of presenters made use of pre-recorded interviews, or short pre-recorded packages inserted into their programmes. These were generally recorded on portable DAT, and transferred to $^1/_4$in. tape for editing. The addition of some of these well edited packages certainly added to the air of professionalism of the station.

Cracker Hits The Road!

In 1995 the organisers felt that something new was needed to revitalise the project. Outside broadcasts were the ideal solution – taking community radio into the community!

The link to the studio was accomplished using a hired Band 1 radio link – which, like the main transmitter had to be licensed. A local sound company converted their covered trailer into a temporary outside broadcast unit, fitted with a 24 channel Soundcraft mixing desk, CD players, tuner, monitor amps, and speakers.

Using custom made adapters, their 'multicore' cable was used to link the trailer to the building which they were visiting. As well as carrying the microphone signals to the desk, this also carried back signals to the PA system amplifier, and 'Talkback' headphones. The presenters and floor managers headphones had the 'off air' signal in one ear, and the producers 'talkback' signal in the other ear. The floor manager had a headset microphone with which he could talk back to the producer in the trailer.

With this setup, Radio Cracker went 'on the road' broadcasting lunchtime shows from local factories, and at night visiting other venues, such as the Leisure Centre, Sportsbowl, and YMCA centre.

Conclusion

The actual broadcasts from Radio Cracker were of a very high standard, despite the fact that the station was operated by amateurs with all the wrong equipment! Perhaps this will be an encouragement to anyone who is an enthusiast in any area of music or sound, who feels that they cannot possibly compete with the 'professionals' with their large budgets and top quality equipment. A little enthusiasm and determination can go a long long way!

A word of warning however, to anyone who is considering setting up a station themselves – plan carefully! Christmas Cracker Ballymena involved over 100 people from all walks of life. Many of these were involved in the Crackerteria and fund raising side of the project, but still an enormous number were involved in the radio station itself. There were 14 technical operators for continuity, and over 30 presenters, not including news and weather readers. On top of this there were readers for advertisements, advertising sales people, public relations people, and a host of others backing up the operation. Community radio most definitely requires community involvement.

A dedicated management committee who are all aware of the stations goals and ideals, and who will work well together to achieve them is a must. But with the right people working together, community radio can be successful, professional, and last but not least, enjoyable and rewarding for everyone involved. ELECTRONICS

Points of Contact

Mechanical Copyright Protection Society, Elgar House, 41 Streatham High Road, London SW16 1ER. Tel: (0181) 769 8792.

Performing Rights Society, 29-33 Berners Street, London W1P 4AA. Tel: (0171) 580 5544.

Phonographic Performance Limited, Ganton House, London W1V 1LB. Tel: (0171) 437 0311.

The Radio Authority, 14 Great Queen Street, Holborn, London WC2B 5DG. Tel: (0171) 430 2724.

Information

Radio Cracker Ballymena are planning to broadcast again at Christmas in 1996. They have had a float at the Mayor's Parade for the town's Summer Festival, and provided a 'roadshow' as part of the festivities. Other events have taken place, with many more planned. Some of those involved are planning a trip to India to see the GMTV/Christmas Cracker hospital, where a ward has been named after the Ballymena group, to mark their contribution to Cracker's third world work.

High Areal Density
DISK DRIVE TECHNOLOGY

by Frank Booty

The figures are fascinating. IBM's $380M infusion into its innovative hard disk drive technology – known as the magnetoresistive recording head or MR head – represents a key expansion of its OEM business. The MR head makes disk drives less costly to build and more reliable. According to Dave Ensberger, vice-president of HDD business line management at storage systems division, "OEM business represents half of our revenue today, and is expected to triple over the next three years. MR head customers are expected to include Hitachi, Fujitsu, and Seagate."

About the size of a pin head, the MR head enables the recording of ever-increasing amounts of data on the part of a hard disk known as a platter. More data can be packed onto a platter with an MR head than on a platter with an existing thin-film head. Units with MR heads are less expensive to build, more reliable, and require less power to operate because they have fewer parts and components. Earlier this year, IBM announced the world's first magnetic disk drive products to exceed one billion bits of data in a square inch of disk space (a billion bits is equivalent to 62,500 double-spaced, typewritten pages, or enough paper to make a stack 7m tall). Drives with 1·3G-bit/in.^{2} – 1·3 billion bits/in.^{2} – areal densities are being marketed, enabling greater capacity for end user data, and enhanced performance through higher data rates.

How's it all achieved? Through a mix of IBM-developed technologies, like MR heads, partial response/maximum likelihood (PRML) channels, and No-ID sector formatting. When IBM announced the MR head back in 1994, market research predicted the number of heads produced would double each year to reach 77·7 million heads this year. While the bean counters will have to wait until 1997 to verify this, consider the 10% growth per year for all heads (including metal-in-gap/ferrite, thin film, and MR) for the same period. IBM's Almaden Research Division near San Jose insists this vigorous demand points to the beginning of the era of magnetosensitive heads for hard disk drives.

Applications for the MR Head

The data storage industry – fast assuming a more key position in the Internet and information superhighway industry – is seizing on MR technology as an enabler in producing competitive products with "superior capacity, performance, and reliability". Back in 1991, Big Blue pioneered the use of MR heads with the introduction of a 1G-byte 3·5in. product that had the industry's highest areal density at the time. Since then, the company has produced a number of industry leading products, including the first 1in. high, 1G-byte disk drive.

The high areal densities attainable with MR heads have enabled IBM to produce disk drive products that permit storage capacity with a minimum number of head and disk components. The theory? Customers receive products with higher reliability for less cost. Products having fewer components also require less power to operate, an important feature for small drive applications in portable, battery operated systems and in large arrays of closely spaced drives, where heat dissipation and cooling can be factors. There has been a huge increase in areal densities for IBM disk drive products since 1980, initially due to thin film head technology. However, recent (post 1991) accelerated 60% compound growth rates have been made possible through the use of MR heads. The areal density of one billion bits of information (gigabits) per square inch of disk surface was demonstrated by IBM back in 1989.

Now the talk is of 10G-bits within the next four years. The MR head's basic design comprises separate read and write elements formed over each other and sharing common material layers. The write element is a thin film inductive head. This optimised design is easier to build than inductive heads that must perform both read and write functions, since it requires fewer copper coils, material layers, photolithographic masking operations, and head tolerance controls. Consequently, higher process yields are achieved, with the knock-on effect of reduced manufacturing and end user costs.

The Magnetic Recording Process

The read element comprises an alloy film, usually NiFe, that exhibits a change in resistance in the presence of a magnetic field – the MR effect. Shielding layers protect the MR elements from other magnetic fields. The second shield also functions as one pole of the inductive write head, giving rise to the term 'merged MR head'. In Figure 1, a merged MR head is shown flying over a rotating disk. The inductive element writes bits of information as magnetically biased regions within radially concentric areas or tracks that are subsequently read by the MR sensor.

The presence of a magnetic transition or flux reversal between bits causes the magnetisation in the MR sensor to rotate. This rotation can be detected directly as a resistance change by a precision amplifier, which produces the stronger signal that relays the information to the disk drive's electronics channel. Electricity passing through the MR sensor creates a magnetic field that interacts with the magnetisation of the underlying soft film. This transverse biasing ensures the magnetic rotation in the MR film occurs at an optimum angle with respect to the sense current, producing the preferred linear responsive MR signal. To maintain the MR sensor's stability and suppress magnetic domain noise, a longitudinal bias is also applied by an additional structure, the exchange bias, or hard bias, layer. This may be configured at and along a junction of the MR element and its electrical contacts.

Sensor element structures featuring both transverse and longitudinal head biasing are used in existing disk drive products. It is expected that MR head technology will continue with a straightforward, scaled evolution to meet future areal density requirements. Advanced, high areal density heads will contain progressively thinner magnetic films and narrower MR elements. In the search for new materials that would allow MR heads to be scaled to the very small dimensions needed for areal densities greater than 1G-bit/in.^{2} while maintaining good signal amplitude, scientists at IBM have developed films that exhibit the 'giant MR' (GMR) effect.

Spin-valve heads – based on GMR structures – produce a different signal amplitude behaviour to magnetoresistive heads as the layer thicknesses are reduced. This unique result is caused by the presence of a thin metal interlayer that maintains micro-magnetic regions within the MR film. GMR structures can produce significant changes in resistance even when exposed to the very small magnetic fields of the bit transitions written on a disk at densities greater than 1G-bit/in.^{2}. It is this evolutionary progress in head development that is expected to drive (sic) the move towards areal densities significantly exceeding 1G-bit/in.^{2}. It should also assure that future IBM disk drive products will continue to enjoy industry leading capacities.

Hot Disking

A recording head serves two functions in a hard disk drive: it writes data onto a disk as well as reading the data back. Until recently, all recording heads used electrical induction for both reading and writing. To write, an electrical current sent through a coil induced a magnetic field within the head that was projected through a small gap onto a spinning disk. To read, the process was reversed: the magnetic fields on the disk were picked up by the gap, inducing a current in the head's coil. This reading process becomes much more difficult as the size of the data bit shrinks because it produces an ever weaker induced current. Also, as the same coil and gap are used for both writing and reading, inevitable design compromises further limit the inductive head's overall performance.

The leap in disk drive technology came in 1991, with the MR reading sensor, made of several thin layers of a magnetic material which changes its electrical resistance in a magnetic field. The MR sensor, which is only some 300 angstroms thick overall or 3,000 times thinner than a human hair, is placed within or near the gap of the write element and provides a much stronger signal when reading data at comparable densities and data rates. The inductive coil and gap could now be optimised solely for writing.

GMR occurs in multi-layer structures of even thinner films (5-100 angstroms each) and was discovered in France in 1988, in perfect crystal samples exposed to very high magnetic fields (20,000 oersted, which is 40,000 times the Earth's magnetic field and 1,000 times that used in disk drives). Research at Almaden opened the door for affordable applications in 1989, when it was shown that more easily made sputtered, polycrystalline multilayers also showed the spectacular GMR effect. A research effort was then instigated to find structures that would exhibit GMR in external magnetic fields weak enough to be useful in a recording head. That research lead to today's spin valve designs.

Stronger signals given out by spin valve heads based on GMR technology provide disk drive designers with the option of packing more bits into a given area of disk surface, thus increasing the data capacity of the disk drive, or relaxing other design constraints to increase performance, such as faster data rate (by spinning the disk faster) or ruggedness and reliability (by flying the head farther from the disk). In fact, much of the data density increases stem from a six-fold decrease in the magnetic bit track width from 3 to 0·5μm that the spin valve design permits, along with necessary improvements in other critical areas. ELECTRONICS

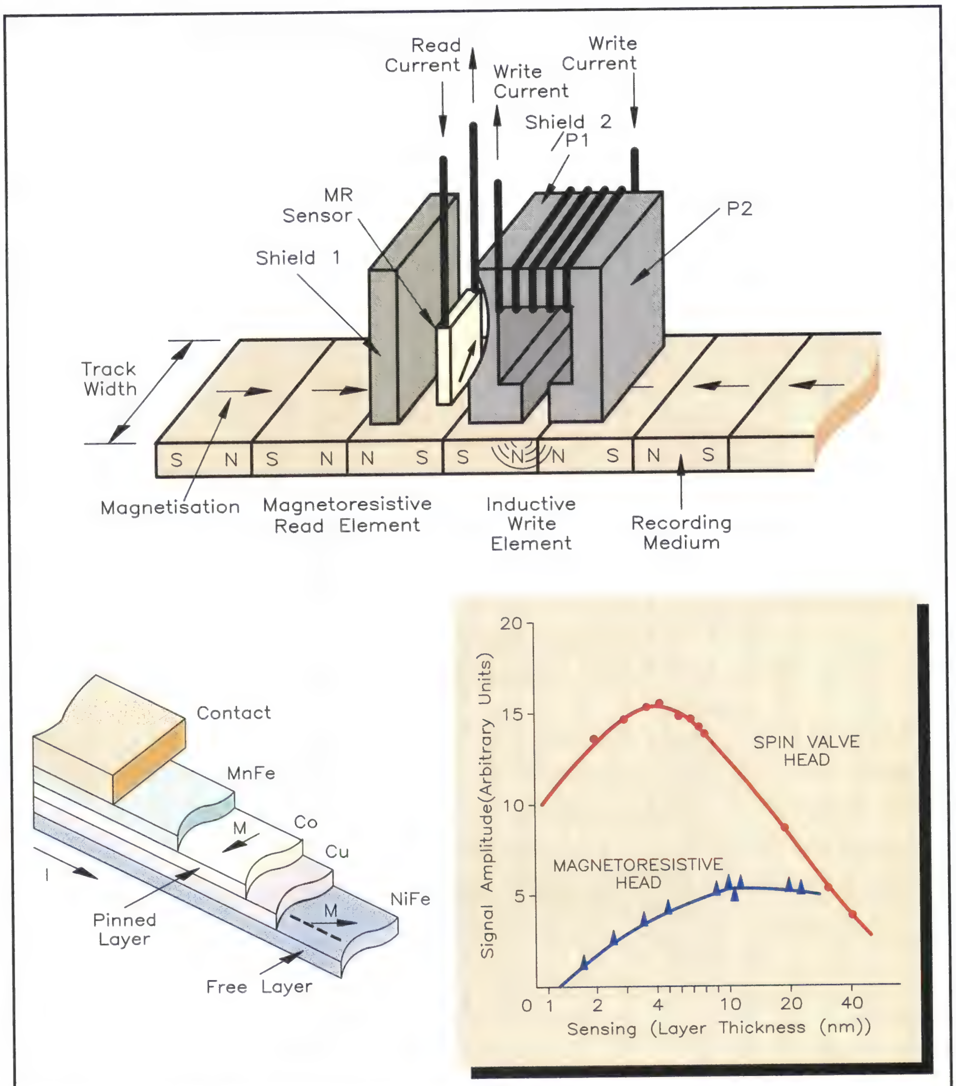


Figure 1. The magnetic recording process, and giant MR/spin valve head performance.

ELECTRONICS CORRIGENDA

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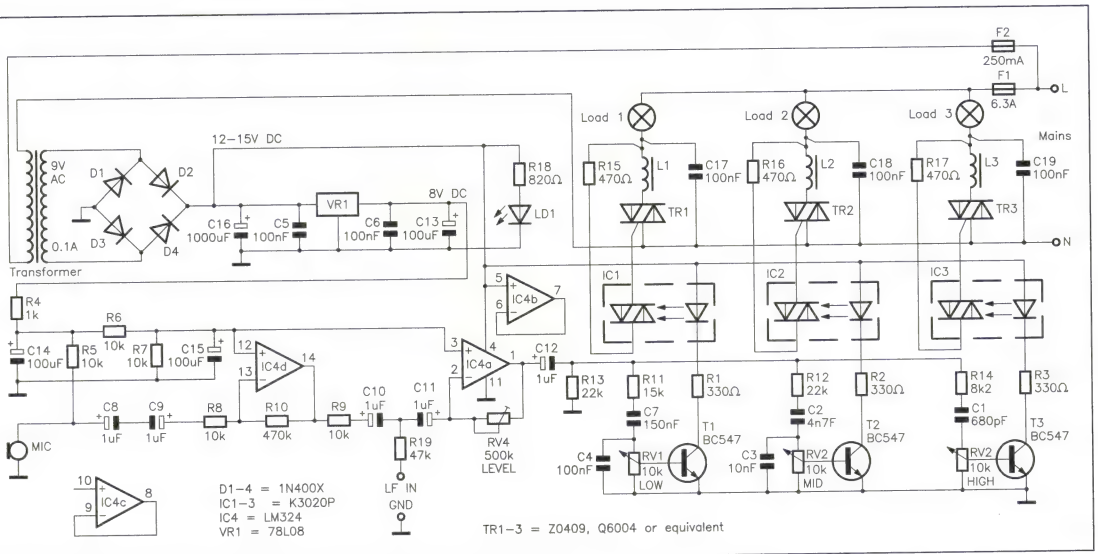
PIC 16C84 Programmer Page 37

The PIC related web site should be addressed as `http://www.man.ac.uk/~mbhstdj/piclinks.html`.

Sound-to-Light Unit Page 50

The circuit diagram shows TR1 to TR3 connected to the 12-15V DC rail, they should cross at these points and not be joined, see amended drawing (right). The layout on the PCB is correct.



Signal Activated AMPLIFIER

Design by Alan Williamson
Text by Alan Williamson and Maurice Hunt

This article describes a versatile general-purpose amplifier with a particularly useful feature – it automatically switches into a power saving standby mode following a preset delay if no signal is present on the input, yet switches back into action (almost) immediately if an input signal again becomes present.

The amplifier has many applications where power saving when the system is not in use is an important consideration, and/or where the amplifier is little used but needs to be active instantly when required. This amplifier will fulfil these requirements without a time-wasting switch-on routine to go through beforehand.

In addition, the amplifier is designed to operate from either an internal battery, or an external power supply. If the optional rechargeable sealed lead-acid battery is installed, the power supply can also be used to trickle charge the battery, even when the amplifier is switched off. This enables the amplifier to be ready for use whenever it is needed. The specified mylar loudspeaker is water resistant, therefore, operation in inclement weather (but not a downpour!) is possible.

PROJECT RATING 2

Kit Available
Order as LT93B
Price £39.99

FEATURES

- Automatic power-saving function
- Adjustable timeout period
- Amplifier active indicator LED
- Built in internal battery charger
- Water-resistant loudspeaker

APPLICATIONS

- Intercoms
- Announcers
- Telephone amplifiers

The completed unit.

Circuit Description

Refer to the block and circuit diagrams, shown in Figures 1 and 2, respectively. The sections are described individually for clarification of their operation.

Amplifier

The TDA2005M (IC1) is a stereo power amplifier IC (optimised for bridged mono, hence the 'M' designation), connected in a non-bootstrapped bridge configuration to increase output swing capability, i.e. one inverting and one non-inverting amplifier with the load (speaker) connected between the two outputs.

The input signal from JK1 is applied to the volume control RV1, then to the input of the non-inverting amplifier, the gain of which is determined by (R1/R4)+1. The feedback signal to the non-inverting amplifier is sniffed off by R3 and applied to the inverting amplifier input, the gain of which is determined by R2/R3+R4.

Connecting a capacitor (C8) to pin 3 of IC1 (the Supply Voltage Ripple Rejection input) will stabilise the ICs internal

bias network; the value of the capacitor is a compromise between 'turn on delay' and 'switch on thump' – larger values for C8 will increase the turn on delay and reduce thump, smaller values will have the opposite effect.

Trigger

The signal from the input socket (JK1) is also applied to RV2, the sensitivity control. TR1 combined with R8 & R9 form a common emitter amplifier, C11 & C13 AC couple the signal in to and out of the amplifier, blocking the DC component; diode D2 half-wave rectifies (clips off the negative half of the waveform) signal, while resistor R10 prevents the input of IC2 from floating.

IC2 is a programmable timer configured in a monostable mode which is retriggerable; when pin 6 is taken high, the output will become active low,

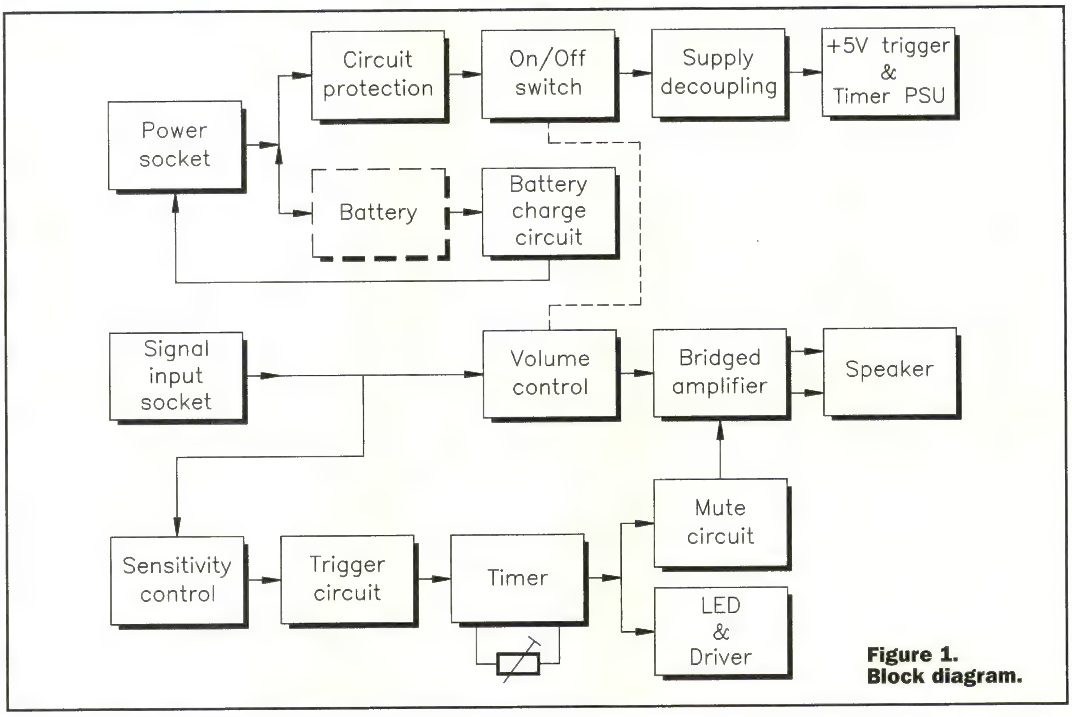


Figure 1. Block diagram.

SPECIFICATION

Operating voltage:	8-15V DC (12V nominal) external PSU or internal sealed lead-acid battery
Standby current consumption:	2·3mA @ 8V 3·7mA @ 12V 39mA @ 15V
Maximum current consumption:	1·2A (activated)
Maximum power consumption:	18W
Delay before standby state activated:	variable, between approximately 25-180 seconds (3 minutes)
Input impedance:	20kΩ
PCB dimensions:	88 × 91mm (before snapping) 88 × 45mm (each PCB when separated)

and the timeout period begins when pin 6 is returned to logic 0. Should the input become high again during the timeout period, the output will remain low but the timeout sequence will be aborted; a new timeout sequence will begin when the input returns to a low condition.

The output period 't' can be calculated from the formula:
$t = 65{,}536 \times 2{\cdot}3 \times (R11 + RV3) \times C14$

With the values given, the minimum timeout period is 24·87 seconds and the maximum period is 180·73 seconds (3 minutes).

Transistor TR2 is used to short circuit C8, keeping the power amp (IC1) in a standby condition until the timer (IC2) is activated. TR3 is used as a power switch for the LED (LD1), which illuminates only when the timer is active.

PSU

Power for the unit can either be derived from the power socket or the internal battery; NOTE that when using an +15V external supply, the internal battery will be trickle charged – even when the unit is switched off. (Note: lower voltage external PSUs will not charge the internal battery.)

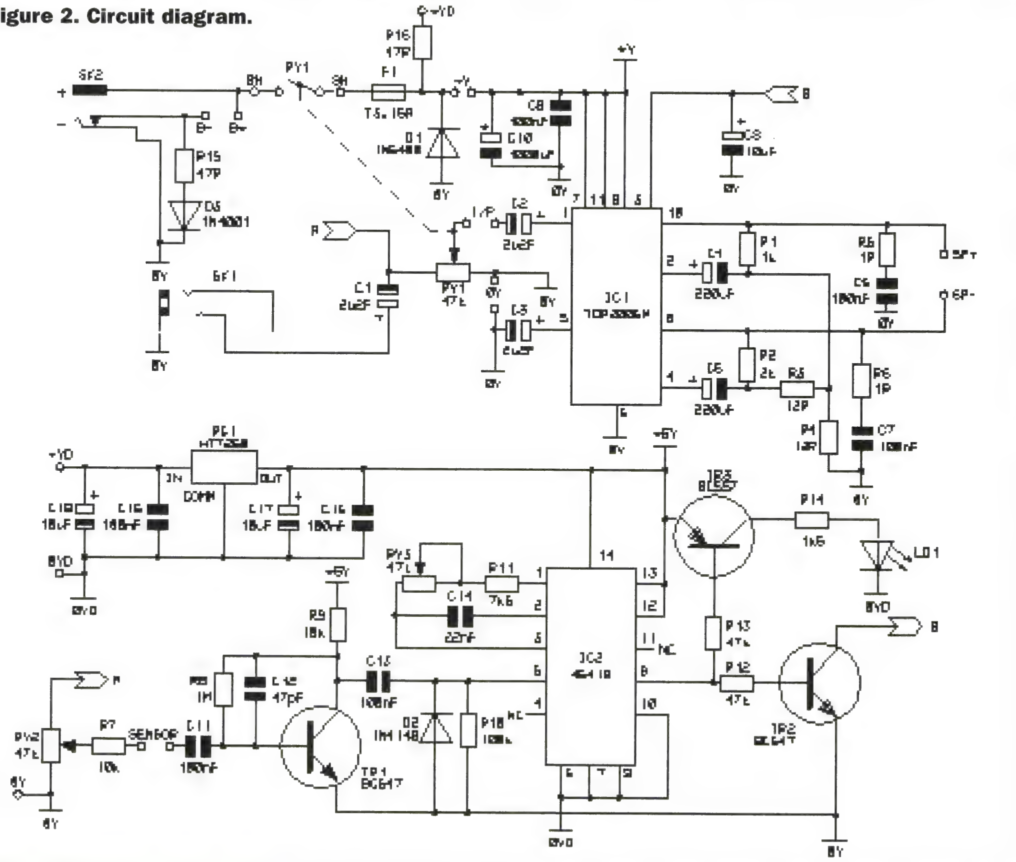
Construction

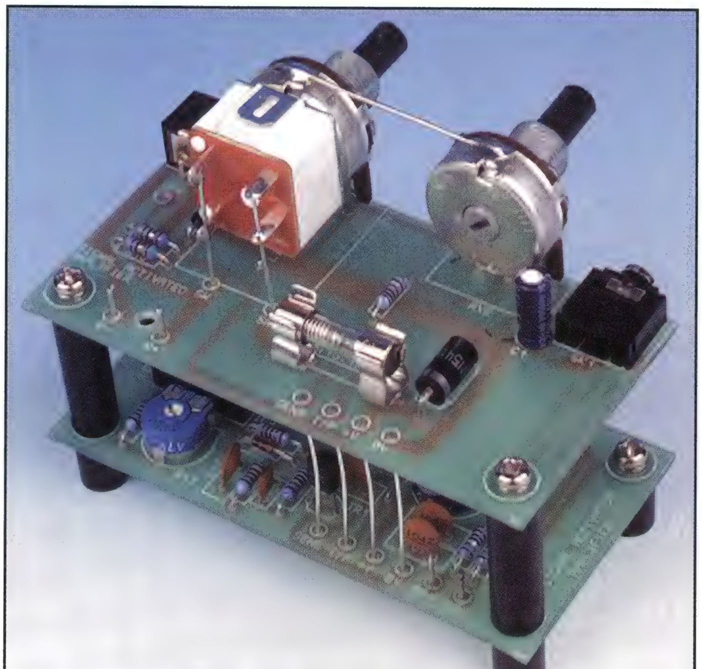
Refer to the PCB legend and track drawing, shown in Figure 3. Construction is fairly straightforward, but a few pointers may be helpful.

Begin with the smallest components first, working up in size to the largest. Be careful to correctly orientate the polarised devices, i.e. electrolytic capacitors, diodes, transistor, regulator and timer IC, which should be inserted into its socket (ensuring the end notches of both align with the PCB legend marking) last of all. Use the component lead offcuts for the PCB links.

The four PCB pins are fitted to B+, B–, SPK+ and SPK–. Fit the clips to the fuse, then insert

Figure 2. Circuit diagram.




The sssembled PCB.

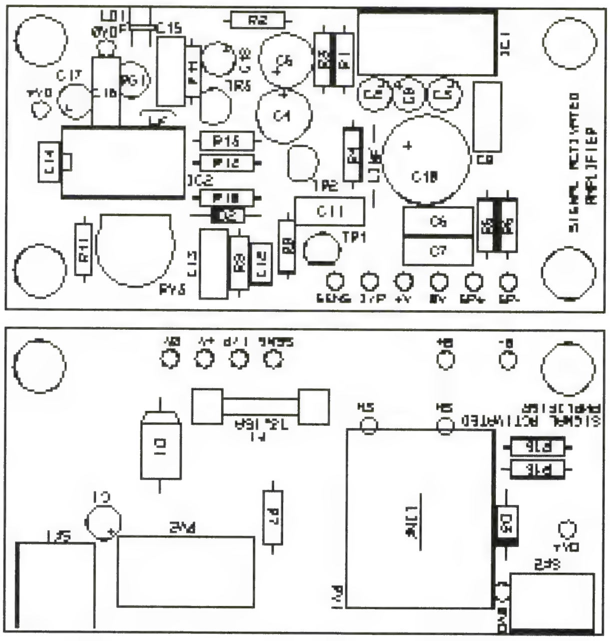


Figure 3. PCB legend and track.

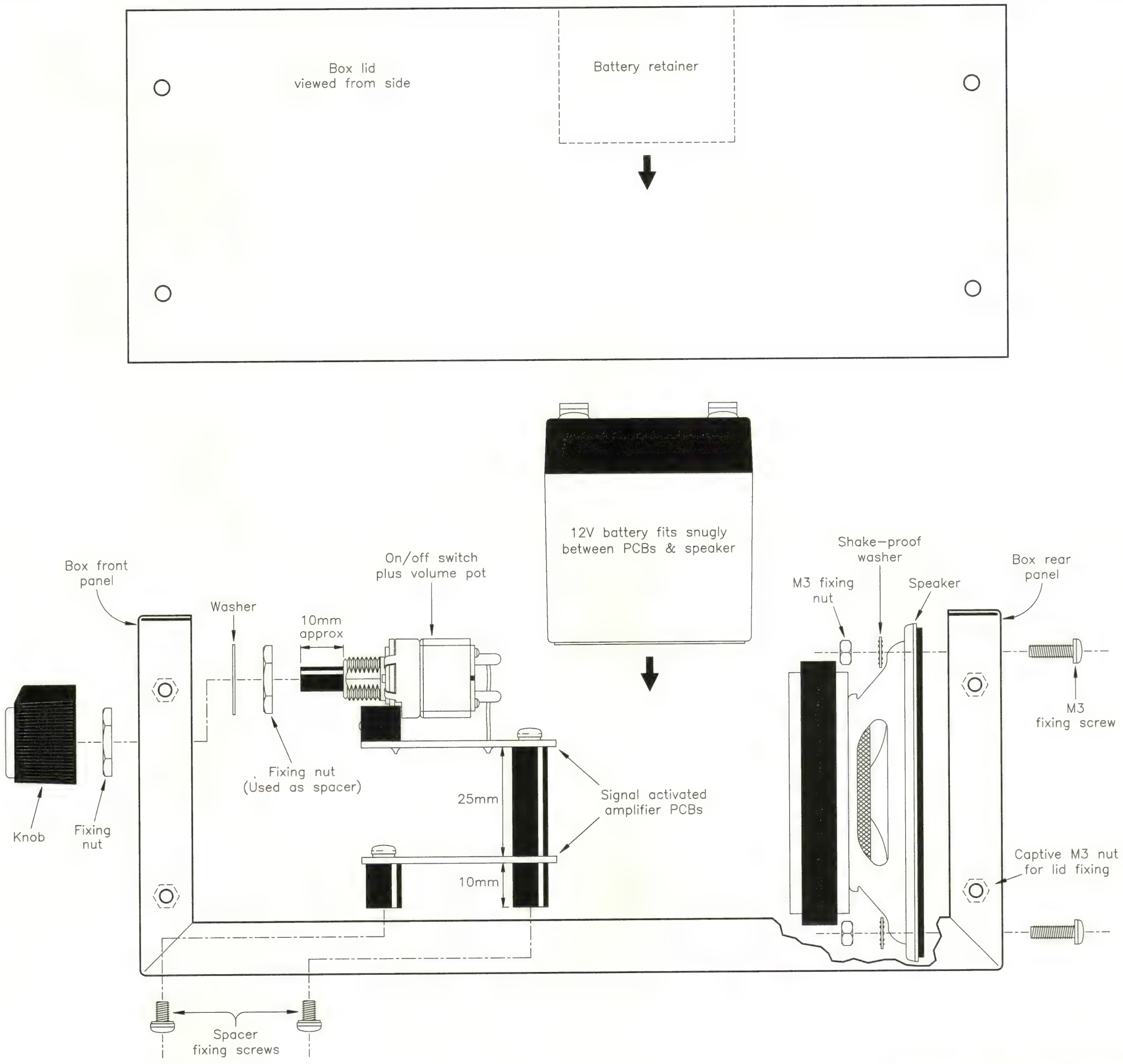


Figure 4. Exploded assembly.

into the PCB. Temporarily fit the 10mm spacers to the bottom PCB, insert the power amp (IC1) and the preformed LED into the PCB; adjust the height of the LED & IC1 to align with the holes in the enclosure, then solder in place. Trim the potentiometer shaft lengths to 10mm before installing into the PCB.

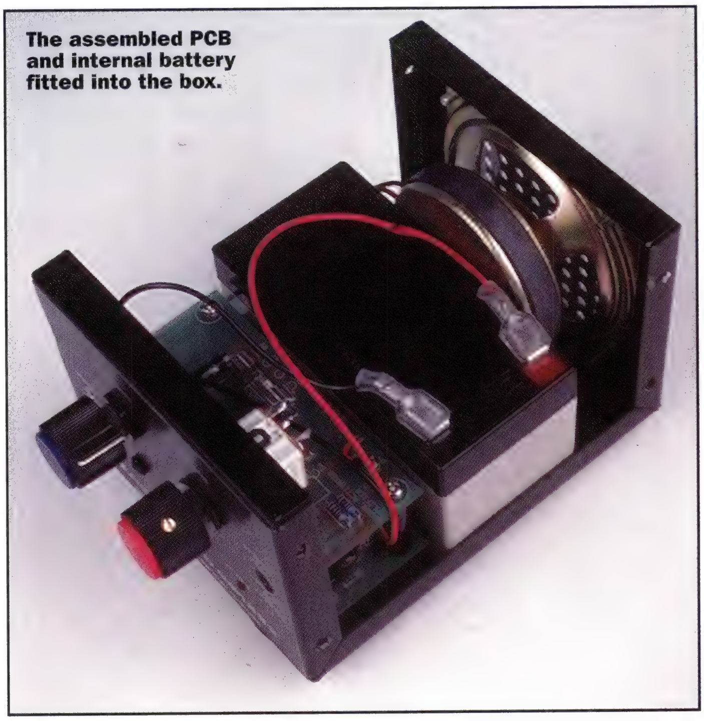
When each PCB is fully populated, thoroughly check your work for misplaced components, solder whiskers, bridges and dry joints. Finally, clean all the flux off the PCB using a suitable solvent.

Refer to Figure 4, the exploded assembly diagram. Prepare the 25mm spacers as shown, then assemble the two PCB's together. Straighten out the tinned copper wire and make the six inter-PCB connections; NOTE that the 0VD connection is also used to connect to the screening cans of the potentiometers. Fit two more links from the top PCB to the switch connections of RV1. Fit the module and speaker into the enclosure.

Referring to Figure 5, complete the wiring to the speaker and internal battery – do not forget to fit the terminal insulators. Finally, fit the knobs to the potentiometer and the rubber feet to the base of the box. Before going any further, double-check EVERYTHING!

Testing

Begin by setting both potentiometers to their fully anticlockwise wiper positions, then put the battery on charge (use a constant voltage charger; Ni-Cd & car battery chargers are NOT suitable for this lead-acid



The assembled PCB and internal battery fitted into the box.

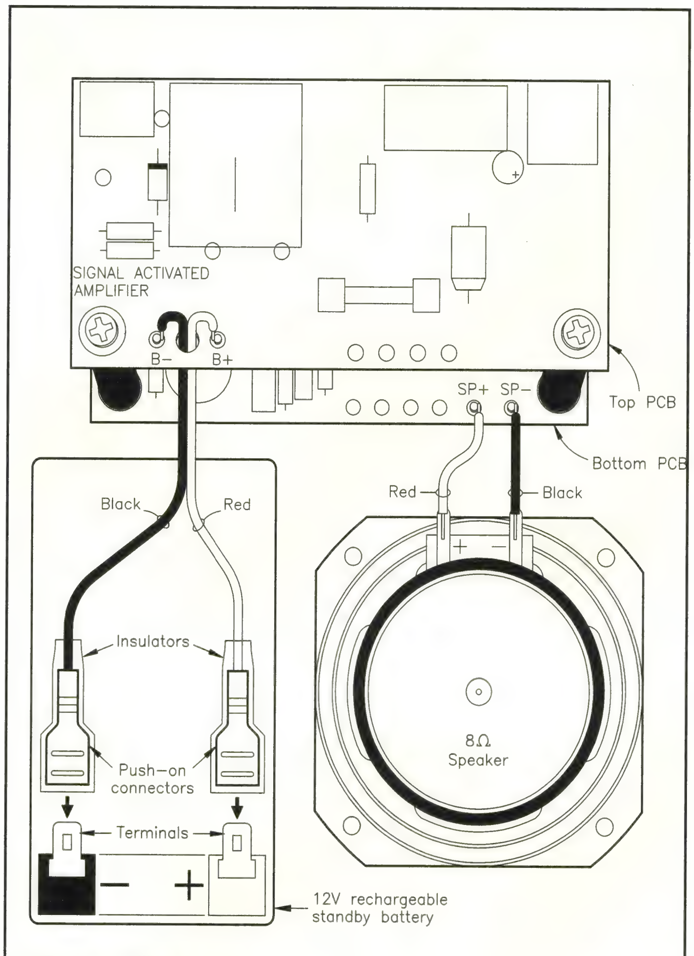


Figure 5. Wiring diagram.

type of battery). Once the battery is fully charged, install it into the enclosure and fit the lid. Switch on the unit by turning the volume control clockwise;
a small click from the speaker will be heard and the LED will illuminate. The length of time the unit is active for is determined by the preset potentiometer RV3; adjust the preset for the desired timeout period.

Allow the unit to 'time out', then apply a signal to the input jack socket – refer to Figure 6, showing the wiring for a typical application. Turn up the volume slightly, then slowly turn the sensitivity control clockwise until the unit triggers; listen to the speaker for any unexpected distortions (bearing in mind that the sound quality is not Hi-Fi).

The unit is now fully tested and is ready for use.

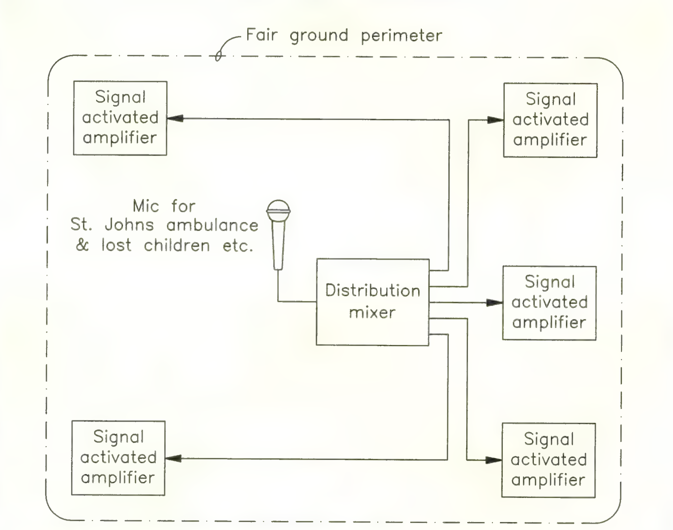

Fair ground perimeter
Signal activated amplifier
Signal activated amplifier
Mic for St. Johns ambulance & lost children etc.
Distribution mixer
Signal activated amplifier
Signal activated amplifier
Signal activated amplifier

Figure 6. Typical application setup.

PROJECT PARTS LIST

RESISTORS (All 0·6W 1% Metal Film, Unless Stated)

R1	1k	1	(M1K)
R2	2k	1	(M2K)
R3,4	12Ω	2	(M12R)
R5,6	1Ω	2	(M1R)
R7,9	10k	2	(M10K)
R8	1M	1	(M1M)
R10	100k	1	(M100K)
R11	7k5	1	(M7K5)
R12,13	47k	2	(M47K)
R14	1k5	1	(M1K5)
R15,16	47Ω	2	(M47R)
RV1	47k Logarithmic Potentiometer with Switch	1	(FW65V)
RV2	47k Linear Potentiometer	1	(FW04E)
RV3	47k Horizontal Enclosed Preset Potentiometer	1	(UH05F)

CAPACITORS

C1,2,3	2μ2F 63V Radial Electrolytic	3	(AT75S)
C4,5	220μF 25V Radial Electrolytic	2	(AT49D)
C6,7,9,11, 13,15,16	100nF 50V Ceramic Disc	7	(BX03D)
C8,17,18	10μF 63V Radial Electrolytic	3	(AT77J)
C10	1,000μF 25V Radial Electrolytic	1	(AT52G)
C12	47pF Ceramic Disc	1	(WX52G)
C14	22nF Mylar Film	1	(WW19V)

SEMICONDUCTORS

D1	1N5400	1	(QL81C)
D2	1N4148	1	(QL80B)
D3	1N4001	1	(QL73Q)
LD1	Miniature Red LED 2mA	1	(CZ28F)
TR1,2	BC547	2	(QQ14Q)
TR3	BC557	1	(QQ16S)
IC1	TDA2005M	1	(YY70M)
IC2	4541B	1	(QQ47B)
RG1	HT7250	1	(LE79L)

MISCELLANEOUS

SK1	3·5mm PCB-mounting Stereo Socket	1	(JM23A)
SK2	2·5mm PCB-mounting DC Power Socket	1	(FK06G)
F1	3·15A 20mm Time Lag Glass Fuse	1 Pkt	(DA01B)
	20mm Fuse Clip Type 2	2	(KU27E)
	1mm Single-ended PCB Pin	1 Pkt	(FL24B)
	14-pin DIL Socket	1	(BL18U)
	0·71mm 22swg Tinned Copper Wire	1	(BL14Q)
	16/0·2 Wire 10m Red	1	(FA33L)
	16/0·2 Wire 10m Black	1	(FA26D)
	M3 10mm Insulated Spacer	1 Pkt	(FS36P)
	M3 25mm Insulated Spacer	1 Pkt	(FS39N)
	M3 10mm Steel Screw	1 Pkt	(JY22Y)
	M3 16mm Steel Screw	1 Pkt	(JY24B)
	M3 Steel Nut	1 Pkt	(JD61R)
	M3 Shakeproof Washer	1 Pkt	(BF44X)
	Mylar Speaker 76mm Square	1	(YN01B)
	Red Knob Type RN15	1	(FE76H)
	Blue Knob Type RN15	1	(FE74R)
	Push-on Receptacle	1 Pkt	(HF10L)
	Push-on Receptacle Covers	1 Pkt	(FE65V)
	Stick-on Feet Square	1 Pkt	(FD75S)
	¼in. Hole Plug	1	(JX60Q)
	PCB	1	(GJ75S)
	Box	1	(BL96E)
	Instruction Leaflet	1	(XZ28F)
	Constructors' Guide	1	(XH79L)

OPTIONAL (Not in Kit)

12V 1·2Ah Lead-Acid Battery	1	(YJ69A)

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.
The above items (excluding Optional) are available as a kit, which offers a saving over buying the parts separately.
Order As LT93B (Signal Activated Amplifier) Price £39.99

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

The following new items (which are included in the kit) are also available separately, but are not shown in the 1996/97 Maplin Catalogue.
Signal Activated Amplifier PCB **Order As GJ75S Price £3.69**
Signal Activated Amplifier Box **Order As BL96E Price £17.99**

MPS

MAPLIN PROFESSIONAL

EDUCATIONAL SUPPLEMENT

December 1996

MPS
MAPLIN PROFESSIONAL

EDUCATIONAL SUPPLEMENT

Welcome to the first of a new series of Educational Supplements from Maplin MPS. We hope pupils and students will find the information presented here useful. A variety of products, those typically used in CDT or the Physics Laboratory are featured here. Many more suitable components and products also appear in the current MPS Catalogue.

Call Maplin MPS now, to order all your components.

Mini-Circuits FOR EDUCATION

Two-Tone Train Horn

This is a simple sound effects unit for model railway enthusiasts. On pressing the push-button switch, a two tone horn sound is produced of the type associated with diesel locomotives. In other words, an initial tone lasting about one second in duration, followed by a tone 50% higher in pitch, and also having a duration of about one second. If preferred, the horn can be triggered automatically at a certain point on the track (just before a level-crossing, for instance). Automatic triggering is possible using a reed switch under the track, and a magnet fitted in a piece of the rolling stock.

The circuit, shown in Figure 1, is based on three 555 timers. Two of these operate as monostables which control the timing of the tones, and the third actually generates the tone. IC3 acts as the tone generator, and it operates in a standard 555 astable mode. The output of IC3 drives a high impedance loudspeaker via a simple low-pass filter (R6 & C5). The filter provides a more realistic sound by removing the higher frequency harmonics in the output signal. Note that IC3 should be a standard 555 and not a low power type. Low power versions of the 555 are not very good at driving low impedance loads, and will not give good results in this circuit. LS1 must be a high impedance (50Ω or greater) loudspeaker, and not an 8Ω type.

IC1 is a standard 555 monostable which has its trigger input taken high by R2 under standby conditions. The trigger input is taken low when S1 is operated, and an output pulse is then generated at pin 3 of IC1. R1 and C2 set the pulse duration at about 2 seconds or so. This pulse is used to control the gate input of IC3. Normally the gate input at pin 4 is held low and no oscillation is produced. During the output pulse from IC1 the gate input is taken high, and a tone is generated by the circuit.

IC2 is the second monostable, and this is triggered at the same time as IC1. It has a shorter output pulse duration which is set at just over one second by R3 and C3. The output pulse from IC2 is coupled to the modulation input of IC3 via VR1. During the initial second or so after triggering, the output of IC2 will be high, and it will pull the output frequency of IC3 lower. IC3 will remain switched on for a little over a second once the output pulse from IC2 has ceased. With IC2's output low, the tone from IC3 is pulled higher in pitch. VR1 is adjusted to give the correct difference between the pitches of the two tones.

Low power 555s are used for IC1 and IC2 in order to minimise the current consumption of the circuit. Under quiescent conditions the current consumption is about 8mA, but it increases to about 20 to 25mA when the horn is sounding. A fairly high capacity battery is needed, such as six AA (HP7) size cells in a plastic holder. Connections to the holder are made via a standard PP3 battery clip.

Construction of the unit is very straightforward. Although the lower power 555s use CMOS technology, they do not require any special handling precautions. If you require manual and automatic triggering, simply wire the reed switch and the push-button switch in parallel. In fact it is possible to trigger the circuit from several reed switches at strategic points around the track by simply wiring them all in parallel. VR1 is adjusted by trial and error to obtain what is judged to be the most realistic effect. When triggering the unit manually make sure that you only operate S1 momentarily. If it is held down for a second or more the timing of the circuit will be affected, and the correct effect will not be produced. If desired, the duration of the sound effect can be changed by altering the values of R1 and R3. The total duration of the sound is proportional to the value of R1. R3 should be maintained at about half the value of R1.

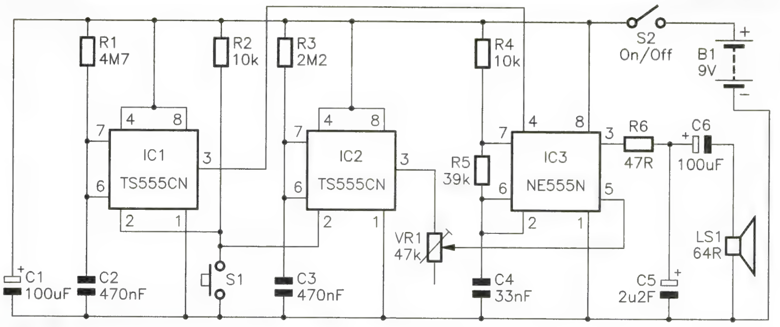
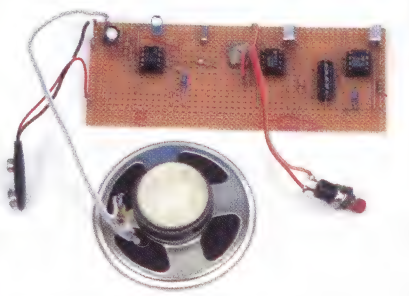


Figure 1. Two-tone train horn circuit diagram.



Prototype two-tone train horn.

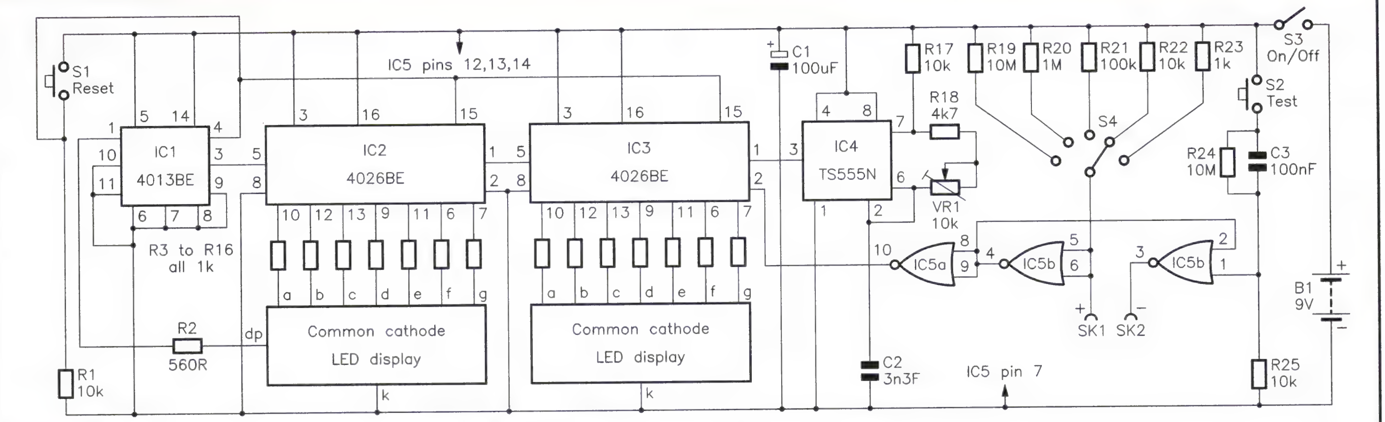


Figure 2. Simple Digital capacitance meter circuit diagram.

Simple Digital Capacitance Meter

This digital capacitance meter provides an interesting alternative to a simple analogue capacitance meter. The cost is comparable to an analogue equivalent, and the resolution and accuracy of the two digit display is at least as good as that provided by a small panel meter. The unit covers a useful spread of capacitance values in its five measuring ranges. These have full-scale values of 990pF, 9·9nF, 99nF, 990nF, and 9·9μF. An overflow indicator is included.

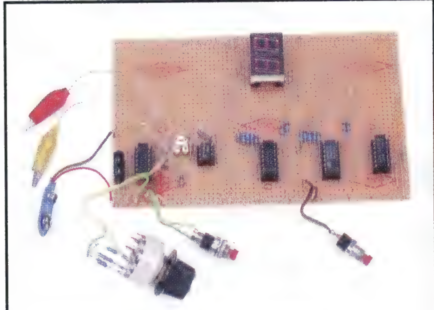
In order to keep the unit as simple as possible the control logic has been kept to a bare minimum. In effect, the user provides some of the control logic by pressing a push-button switch when a reading is required, and operating a second button to reset the display to zero before the next reading is taken. The circuit diagram is shown in Figure 2. Looking at the operation of the circuit in broad terms, IC5 acts as a monostable which has the test capacitance as the capacitive element of the C-R timing circuit. IC4 acts as a clock oscillator which feeds into a two digit counter based on IC2 and IC3. The output pulse from the monostable controls the gate input of the counter circuit, and the count only proceeds during an output pulse from the monostable. The higher the test capacitance, the longer the monostable pulse duration, and the higher the count. There is a linear relationship between the test capacitance and the number of clock pulses registered by the counter. In practice the clock frequency is chosen so that the counter directly indicates the test capacitance.

Looking at the circuit in a bit more detail, the monostable is based on two CMOS NOR gates (IC5b and IC5c). The low self-capacitance of this configuration ensures good accuracy with small test capacitances. IC5a acts as an inverter at the output of the monostable. This gives a better output waveform and also provides output pulses of the correct polarity for the gate input of IC3. The fourth gate in IC5 is left unused. S4 provides five switched timing resistances which give the unit its five ranges. R19 provides the 990pF range – R23 provides the 9·9μF range. S2 is used to trigger the monostable and take a reading. R24 and C3 provide 'debouncing' for S2.

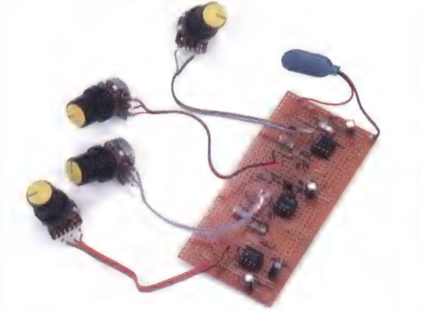
The clock oscillator is a standard 555 astable. A low power 555 is used in order to keep the current drain from the battery as low as possible. VR1 enables the clock frequency to be adjusted, and this is the calibration control. The counter is a straightforward design based on two CMOS 4026BE decade counters and display drivers. The carry out output of IC2 drives the input of a 'D' type flip/flop (IC1). The 4013BE is actually a dual flip/flop, but in this circuit only one section is utilized. This acts as a sort of data latch which switches on the overflow indicator if the count goes beyond '99'. With a two digit display and right-hand decimal points, it is not really possible to use the decimal point segments for their intended purpose. Therefore, the decimal point of one display is used as the overflow indicator, and the other one is simply left unused. It is still quite easy to convert readings into their corresponding capacitance values. S1 is used to reset both the main display and the overflow indicator. The current consumption of the circuit varies depending on the number of display segments that are switched on, but it is in the region of 50mA. This requires the use of a fairly high capacity battery, such as six AA (HP7) size cells in a holder.

When constructing this project bear in mind that, apart from IC4, the integrated circuits are CMOS types. They therefore require the standard antistatic handling precautions. The displays must be common cathode LED types. IC3 drives the units display (i.e. the right-hand display). A holder for the display is made by cutting a 20-pin DIL holder into two 10-pin SIL types, or 'Soldercon' pins can be used. SK1 and SK2 can be a couple of 1mm sockets mounted on the front panel of the unit, and many capacitors will readily connect to these. However, a couple of test leads terminated in small crocodile clips will be needed in order to make the connections to some types of capacitor. Alternatively, a pair of crocodile clip leads can simply be hard wired direct to the circuit board.

A close tolerance capacitor is needed in order to calibrate the unit. The unit can be calibrated on any range, and the value of the calibration capacitor should be at least half the full-scale value. For example, an 8·2nF capacitor could be used to calibrate the unit on the 9·9nF range (R20 switched into circuit). A series of readings would be taken, and RV1 would be adjusted by trial and error to obtain a consistent readings of '82' on the display. One final point is that capacitors should always be discharged before connecting them to any capacitance meter.



Prototype digital capacitance meter.



Prototype simple graphic equaliser.

Simple Graphic Equaliser

A full-blown graphic equaliser covers the entire audio range in about eight to ten bands, with each level control covering roughly one octave. These days many audio devices incorporate a sort of cut down version of graphic equaliser. These are frequently found in 'ghetto blasters', and even personal stereo units. They usually have four or five level controls with each one covering a couple of octaves or so. This obviously gives far less precise control than a full graphic equaliser, but, on the other hand, it is much better than simple bass and treble tone controls.

The circuit in Figure 3 is for a simple four band graphic equaliser. The approximate centre frequencies of the controls are 80Hz, 400Hz, 1·8kHz, and 8kHz. These respectively control the bass, lower middle, upper middle, and treble frequencies. Each control can provide a maximum of about 12dB of boost and cut at its centre frequency. The frequency response is essentially flat with all four controls centred, and the voltage gain is then approximately unity.

IC1 acts as a buffer stage at the input of the circuit, and it provides an input impedance of about 50kΩ. The buffer stage is followed by a series of four response shaping circuits, one for each band. All four stages utilize the same configuration, and this is based on an operational amplifier in the inverting mode. R4, R5 and C3 provide a half supply bias for the non-inverting inputs of all four stages.

If we consider the operation of the first stage (which is based on IC3a and covers the lowest frequency band), R3 and R6 are a negative feedback network which sets the voltage gain at unity. However, frequency selective negative feedback is provided by R7, R8, VR1, C4, and C5. If we ignore C5 for the moment, C4 significantly shunts R6 at high frequencies when the wiper of VR1 is at the top end of its track. This gives increased feedback at high frequencies, and high-frequency cut. With the wiper of VR1 at the bottom end of its track, C4 shunts R3 at high frequencies. This gives reduced negative feedback and high-frequency boost. R3 and R8

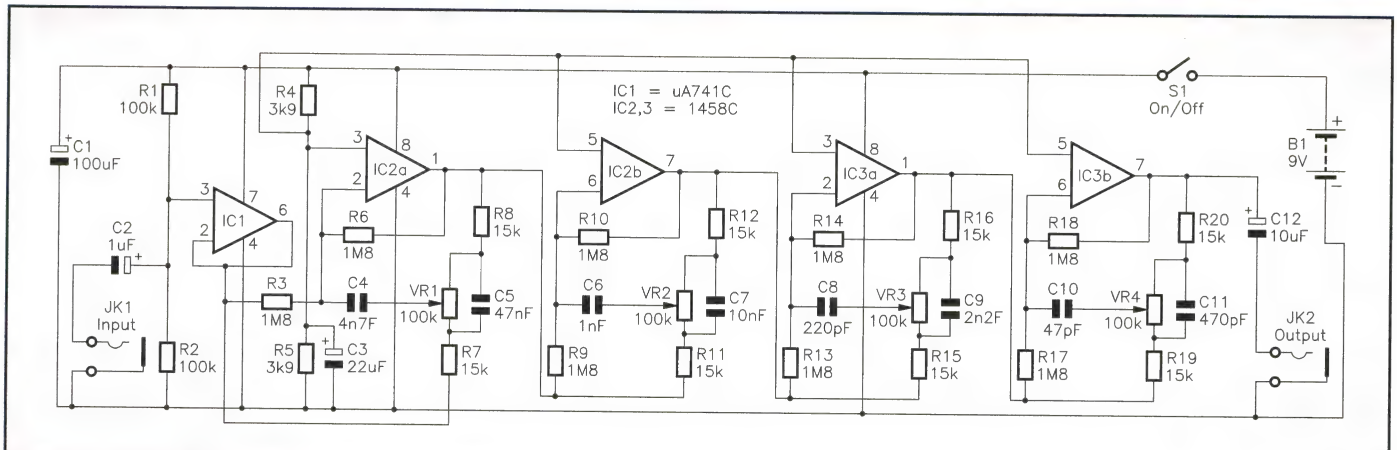


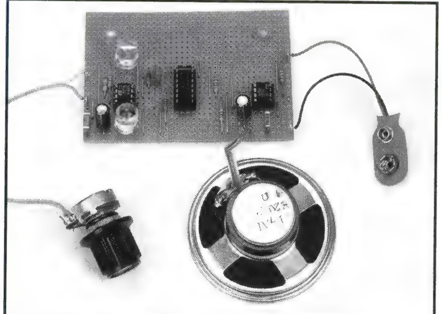
Figure 3. Simple graphic equaliser circuit diagram.

limit the effect of C4, and keep the maximum amounts of boost and cut within reasonable bounds. C5 is used to effectively short circuit VR1 at high frequencies, which nullifies C4 and leaves the circuit with its basic unity voltage gain. The circuit values are chosen so that C4 can introduce high-frequency boost or cut over the frequency range that is of interest, but C5 eliminates any doctoring of the frequency response at higher frequencies. The steadily reducing capacitance values used in the subsequent stages results in them covering progressively higher frequency ranges.

The component layout is not particularly critical since the circuit can only produce a modest amount of voltage gain. It should be borne in mind that setting a level control for 'cut' results in the relevant operational amplifier having less than unity voltage gain. This does not seem to produce any problems using 1458Cs for IC2 and IC3, but many operational amplifiers can become unstable when used at less than unity voltage gain. The LF353N for example, does not seem to work well in this circuit, with severe high-frequency instability occurring at some control settings. It is therefore advisable to use the humble 1458C for IC2 and IC3, rather than a more modern device, unless the alternative device is known to be stable when used at less than unity voltage gain. The current consumption of the circuit is only about 5mA, and a PP3 battery is therefore perfectly adequate as the power source.

Audio/Visual Metronome

The original metronomes were purely mechanical devices having clockwork mechanisms ('Maelzel's' metronomes). These are rapidly becoming collectors items, and modern metronomes are of the electronic variety. Mechanical metronomes have a swinging arm, rather like an inverted pendulum, and they produce a 'clicking' sound each time the arm reaches the limit of its swing. This gives both a visual and an audible indication of the beat rate.



Prototype audio/visual metronome.

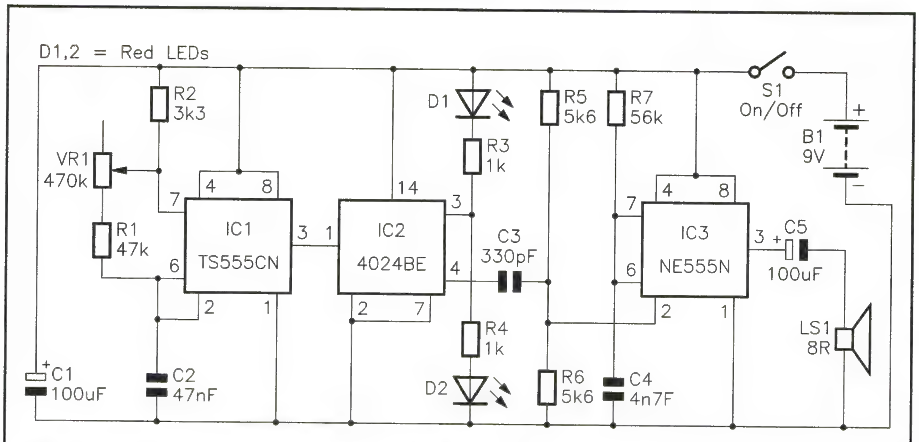


Figure 4. Audio/visual metronome circuit diagram.

This electronic metronome also produces a series of 'clicking' sounds to give an audible indication of the beat, and it provides a visual indication via two large LEDs. The LEDs are operated in anti-phase (i.e. as one switches on the other switches off), giving a form of visual indication that is roughly analogous to the swinging arm of a mechanical metronome. The beat rate can be varied from approximately 30 to 300 beats per minute.

The circuit in Figure 4 is based on two 555 timers and a CMOS 7-stage binary counter. IC1 is the clock generator, and it is a low power 555 timer used in the standard astable mode. An ordinary 555 can be used for IC1, but this will increase the current consumption of the circuit by about 8mA, with a much shorter battery life. The timing components are R1, R2, VR1, and C2. Although the 'click' rate is in the frequency range 0·5Hz to 5Hz, the clock oscillator has to operate over a much higher range of frequencies as it drives the speaker via 6 stages of the binary divider. It therefore operates at 64 times the output frequency, or in other words at around 32 to 320Hz. An advantage of this system is that it avoids the expense of a good quality, high value timing capacitor.

IC2 is the seven stage binary divider, a CMOS 4024BE. C3 couples the output from the sixth stage of IC2 to the input of a 555 based monostable circuit. The trigger input of IC3 is biased to about half the supply voltage by R5 and R6. Negative output transitions from pin 4 of IC2 briefly take the trigger input of IC3 below one third of the supply potential, and an output pulse is produced at pin 3 of IC3. R7 and C4 set the duration of the output pulse at a fraction of a millisecond, which gives a suitably high pitched 'click' sound. C5 couples the output pulses from IC3 to a moving coil loudspeaker. I would not recommend using a low power version of the 555 timer for IC3 as many of these seem to give erratic operation when driving low impedance loads. Also, the output stages of some low power 555s cannot supply high enough output currents to give good results in this application.

The output of IC2's seventh divider stage is used to drive the two LEDs, which are connected so that they operate out-of-phase. D2 is switched on when pin 3 of IC2 goes high – D1 is switched on when it goes low. As each LED only switches on at every other 'click', the LEDs are operating at half the 'click' frequency. Hence the LEDs are driven from stage seven of IC2 while the 'click' generator is driven from stage six.

The current consumption of the circuit is about 12mA. This necessitates the use of a fairly high capacity battery, such as six HP7 size cells in a plastic holder. Construction of the unit is fairly straightforward, and the component layout is not critical. Bear in mind though, that IC2 is a CMOS device which requires the standard antistatic handling precautions. Virtually any LEDs are suitable for D1 and D2, but large high efficiency LEDs will be much more conspicuous than small low efficiency types. A scale calibrated in beats per minute must be marked around VR1's control knob. The calibration points must be found by trial and error, with the beat rate being determined by counting the number of 'clicks' in a one minute period. At high beat rates adequate accuracy should be obtained by counting the number of 'clicks' in twenty seconds, and then multiplying by three to get the beats per minute.

Model Train Signal Lights

This is a circuit for a simple three-colour signal for a model railway. It operates automatically, changing from 'green' to 'red' as the train passes the signal. After a preset time the signal changes to 'amber', and after a further period it goes back to 'green' once again. This is a sort of simplified version of the real thing, where the signals change as the train passes by sensors along the track. In this case there is only one sensor, which is positioned beside the signal. The other changes are provided by a timing circuit, which is slightly less authentic, but makes the signal much easier to install.

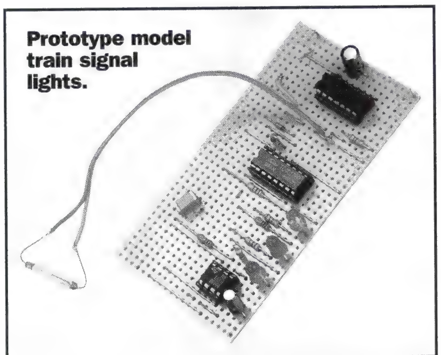
The circuit, shown in Figure 5, is built around IC2, which is a CMOS decade counter and one-of-ten decoder. In this case only outputs '0' to '3' of the decoder section are utilized, the other seven outputs are simply ignored.

C3, R7, and D4 supply a reset pulse to IC2 at switch-on, so that it commences with output '0' high. This switches on D1, which is the 'green' signal LED. IC1 is a 555 timer which is used here as a low-frequency clock oscillator which provides a clock pulse to IC2 every three seconds or so. The first clock pulse results in the '0' output going low, and output '1' going high. This switches off D1, and switches on D2 (the 'red' signal LED). On the next clock pulse output '1' goes low and output '2' goes high. This results in D2 switching off, and the 'amber' LED (D3) turning on. On the next clock pulse output '4' goes high, but due to the coupling through R6 this resets IC2 so that output '4' immediately returns to the low state, and output '0' goes high. This takes the circuit back to its initial state, with D1 switched on, and a 'green' signal being produced.

Some control logic is needed, so that the circuit only goes through this sequence of events when it is triggered by the passing train. The circuit must halt once it has cycled back to a 'green' signal. This control logic is provided by IC3, which is a 4013BE dual 'D' type flip/flop. In this circuit only one section of the device is used. The inputs of the unused section of IC3 are connected to the 0V supply in order to protect them against static charges and to avoid spurious operations. The other section operates really as just a simple set/reset flip/flop, with the clock and data inputs simply being wired to earth. Like IC2, IC3 is supplied with a reset pulse at switch-on. This takes the Q output low, which in turn inhibits IC1 so that no clock signal is produced. R8 ties the 'set' input of IC3 to earth, but this input is pulsed high when sensor switch S1 is activated. This takes the Q output of the flip/flop high, and activates IC3. This results in the signal changing to 'red' immediately, and to 'amber' and then 'green' after a few seconds. IC3 is reset when output '4' of IC2 pulses high, so that once the signal returns to 'green', the Q output of IC3 inhibits IC1. This holds the signal at green until S1 is activated again. The sequence is then repeated, and will be repeated each time S1 is activated. The current consumption of the circuit is about 15mA, or about 7mA if a low power 555 is used for IC1.

Construction of the actual railway signal is obviously unusual. D1 to D3 must be mounted in a model signal, and it is not too difficult to improvise something reasonably convincing. Rather than controlling the LEDs directly, IC2 could be used to control them via common emitter switching transistors. This would enable a higher drive current to be used, and would also permit miniature filament bulbs to be used. S1 can be either a micro-switch or a reed type. In the case of a micro-switch, things must be arranged so that the actuator is operated by the passing train. For this application a reed switch mounted under the track is preferred. This is operated by a small bar magnet fitted in a piece of rolling stock. This method requires no direct contact with the train, which eliminates any slight risk of occasional derailments. Note that IC2 and IC3 are CMOS devices which require the usual antistatic handling precautions. The duration of the 'red' and 'amber' signals is easily altered as it is roughly proportional to the value of R2.

Prototype model train signal lights.



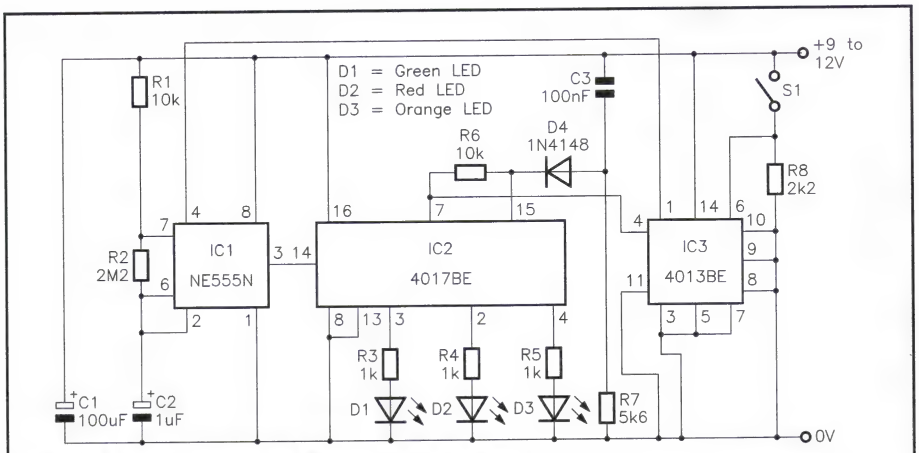
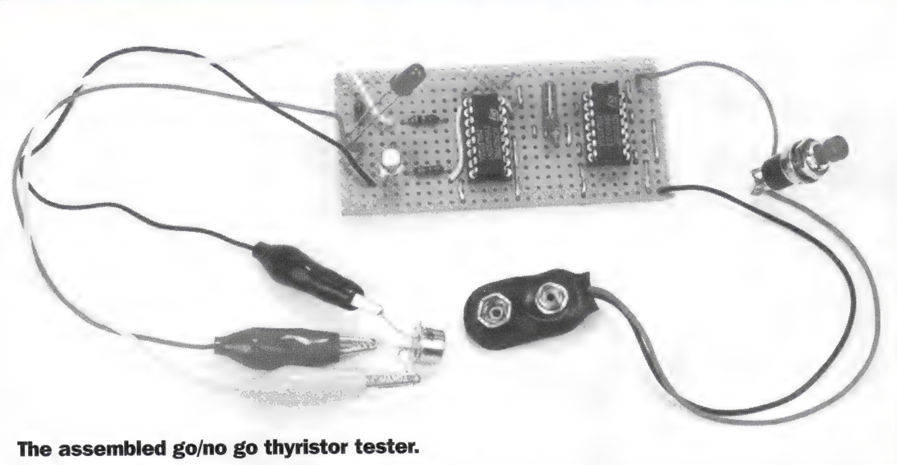


Figure 5. Model train signal lights circuit diagram.



The assembled go/no go thyristor tester.

Go/No Go Thyristor Tester

This circuit (Figure 6) was designed to give a quick go/no go test of thyristors that you might find in 'bargain packs', etc. Thyristors are also known as silicon controlled rectifiers. They are like a diode, in that current can only flow one way through it. However, the thyristor has an additional terminal, known as the gate; if sufficient current is applied to the gate, then the device will stay permanently latched on. The only way to turn the device off is to either short-circuit the anode-cathode junction, or reduce the anode-cathode current below the 'holding' current, which is the minimum current necessary to keep the device on. The former method was used in this circuit. It is also possible to test thyristors using a multimeter, but this circuit has the advantage of being less 'fiddly' to use, and it also gives you an idea of how well the device under test switches from a non-conducting to conducting state.

Circuit operation is as follows: IC1a and b form a standard astable multivibrator, with a working frequency of about 2·5Hz; R1 and C1 set the frequency of the astable. Pulses from the astable are fed to the clock input of IC2, which is a '1-of-10 decoder'. As successive pulses are fed to IC2, each of its outputs will go high then low, in sequence. When the last output goes high/low, the sequence starts again. When output 1 of IC2 goes high – roughly to the supply voltage – this voltage will be fed to the gate of the device under test through R2. This turns on the thyristor, and LD1 will be illuminated. R4 is the current limiting resistor for LD1.

Now, two clock pulses later, output 3 of IC2 will go high, and this turns TR1 fully on, short-circuiting the anode-cathode junction of the device under test and, therefore, turning it off. LD1 will now be extinguished. When output 7 of IC2 goes high five clock pulses later, IC2 is reset and the whole sequence starts over again. S1 is the on/off switch, and must be pressed down long enough to see if the device under test works. C2 is a supply decoupling capacitor.

If, when testing a thyristor, LD1 is permanently on, or it does not come on at all, then the thyristor is probably suspect. When connecting a device to be tested, you can use either flying leads and clips, or sockets. Flying leads and clips were used on the prototype. A red lead and clip were used for connecting to the anode, a black lead and clip to the cathode, and a yellow lead and clip to the gate. Current consumption of the unit is about 11mA.

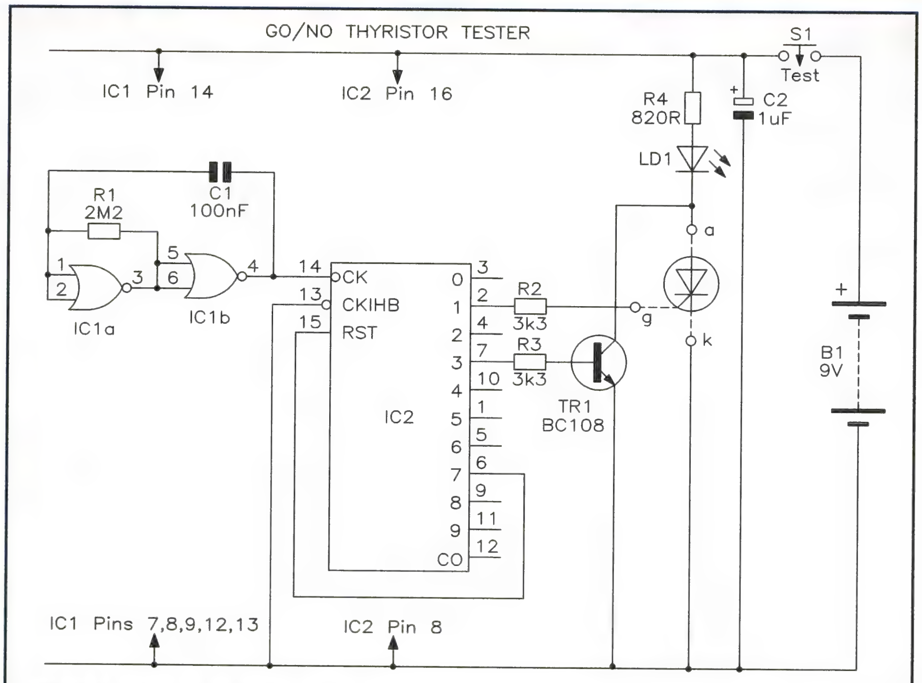


Figure 6. Go/no go thyristor tester.

Soil Moisture Tester

This circuit (Figure 7) was designed to give gardeners a quick indication of how wet or dry the soil is in their gardens or greenhouses. It can also be used to test how wet or dry the soil of house plants is. The usual way to determine the wetness or dryness of soil electronically is to measure the resistance of the soil, and then give some kind of visual or aural indication of its value. For a visual indication, you can use circuits that drive moving coil meters or bar graph displays. However, these can be costly. It was decided to use a circuit that gave an audible indication of soil resistance because it was cheaper, and with practice you can gauge the wetness of the soil quite quickly.

The circuit is described below. It is based around a well-known square wave oscillator circuit. IC1a is an integrator, with C2 being charged and discharged through RV1, the soil resistance, and R5. IC1b forms a Schmitt trigger circuit, whose switching points are determined by R3 and R4. When the soil is wet, its resistance will be low, and therefore C2 charges and discharges faster. Therefore, the frequency of oscillation of the circuit will be higher. When the soil is dry, the resistance between the probes will be higher, and C2 will charge and discharge at a slower rate, and the frequency of oscillation of the circuit will be lower. RV1 allows the frequency of operation to be varied when the circuit is in use. The frequency of operation can be varied between about 1·3kHz for very wet soil, down to 100Hz or less for very dry soil. R1 and R2 are biasing components for IC1a and IC1b, setting the non-inverting and inverting inputs to half of the supply voltage. C1 provides AC decoupling for R2. C3 feeds the output of IC1b to LS1. It may seem unusual not to have some kind of buffer circuit between the output of IC1b and the loudspeaker, but there is enough drive from the output of IC1b to drive a high impedance speaker at a reasonable volume. The current consumption of the unit is around 9mA.

To use the circuit, place the probes into the soil to be tested, press S1 and note the tone. A low tone means that your soil is dry and should be watered. A high tone means that your soil is wet and should not be watered.

There are no special construction requirements for this circuit. The probes were made using bolts, solder tags and nuts for fixing to whatever type of case you decide to use.

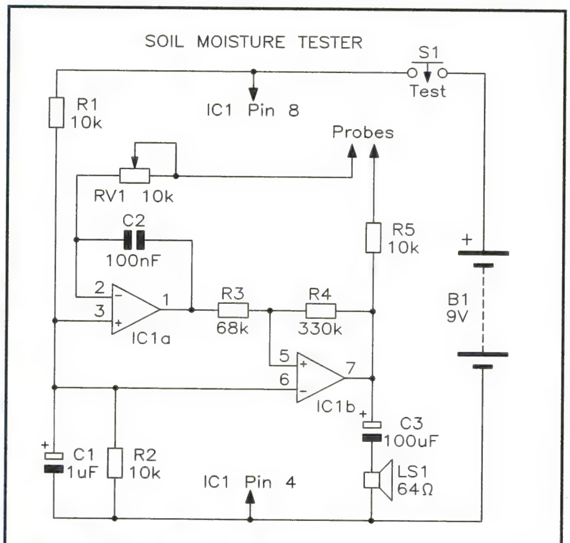
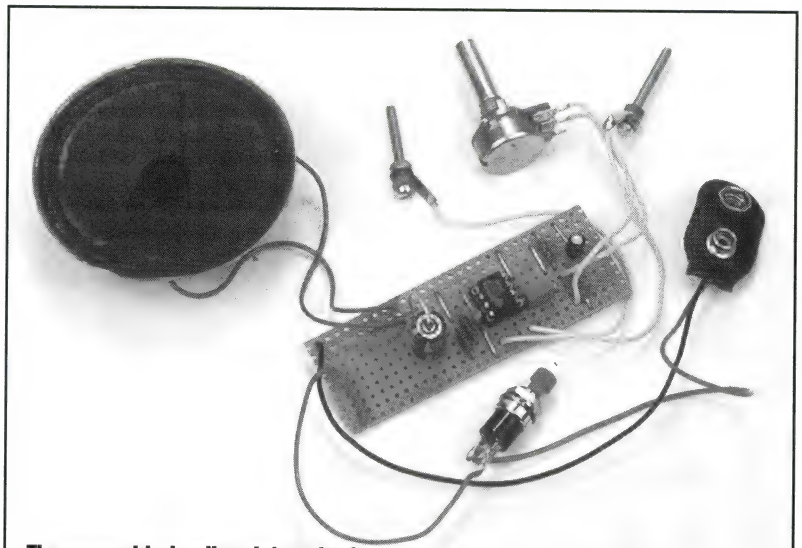
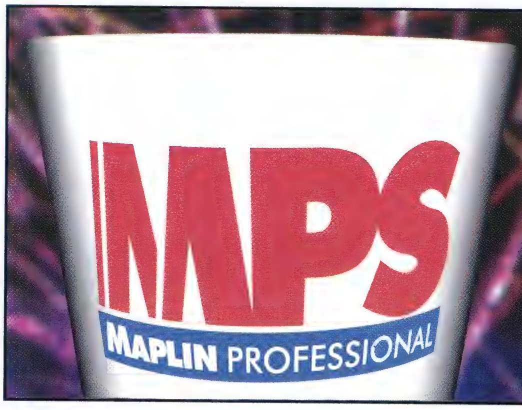


Figure 7. Soil moisture tester.



The assembled soil moisture tester.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Mini-Circuits PARTS LISTS

TWO-TONE TRAIN HORN

RESISTORS: All 0·6W 1% Metal Film (Unless specified)

R1	4M7	1	(M4M7)
R2,4	10k	2	(M10K)
R3	2M2	1	(M2M2)
R5	39k	1	(M39K)
R6	47Ω	1	(M47R)
RV1	47k Miniature Horizontal Preset	1	(UH05V)

CAPACITORS

C1	100μF 10V Electrolytic	1	(FB48C)
C2,3	470nF Polyester Layer	2	(WW49D)
C4	33nF Polyester Layer	1	(WW35Q)
C5	2μ2F 100V PC Electrolytic	1	(FB15R)
C6	100μF 10V PC Electrolytic	1	(FF10L)

SEMICONDUCTORS

IC1,2	TS555CN	2	(RA76H)
IC3	NE555N	1	(QH66W)

MISCELLANEOUS

LS1	66mm Diameter 64Ω Speaker	1	(WF57M)
S1	Push to Make Switch (see text)	1	(FH59P)
S2	SPST Ultra Miniature Toggle	1	(FH97F)
B1	AA Size Cells	6	(FK55K)
	6 3 AA Battery Holder	1	(HQ01B)
	Battery Clip	1	(HF28F)
	8-Pin DIL Socket	3	(BL17T)

DIGITAL CAPACITANCE METER

RESISTORS: All 0·6W 1% Metal Film (Unless specified)

R1,17, 22,25	10k	4	(M10K)
R2	560Ω	1	(M560R)
R3 to 16, R23	1k	15	(M1K)
R18	4k7	1	(M4k7)
R19,24	10M	2	(M10M)
R20	1M	1	(M1M)
R21	100k	1	M100K)
VR1	10k Miniature Horizontal Preset	1	(UH03D)

CAPACITORS

C1	100μF 10V Electrolytic	1	(FB48C)
C2	3n3F Polyester Layer	1	(WW25C)
C3	100nF Polyester Film	1	(BX76H)

SEMICONDUCTORS

IC1	4013BE	1	(QX07H)
IC2,3	4026BE	1	(QX15R)
IC4	TS555N	1	(RA76H)
IC5	4001BE	1	(QX01B)
Display 1,2	0·5in. Common Cathode 7-Segment Display	2	(FR41U)

MISCELLANEOUS

S1,2	Push to Make Switch	2	(FH59P)
S3	SPST Miniature Toggle Switch	1	(FH97F)
S4	6-Way 2-Pole Rotary Switch	1	(FF74R)
SK1	Miniature Red Crocodile Clip	1	(FM37S)
SK2	Miniature Black Crocodile Clip	1	(FK34M)
B1	AA Size Cells	6	(FK55K)
	6 3 AA Battery Holder	1	(HQ01B)
	Battery Clip	1	(HF28F)
	8-Pin DIL IC Socket	1	(BL17T)
	14-Pin DIL IC Socket	2	(BL18U)
	16-Pin DIL IC Socket	2	(BL19V)
	20-Pin DIL IC Socket	1	(HQ77J)

SIMPLE GRAPHIC EQUALISER

RESISTORS: All 0·6W 1% Metal Film (Unless specified)

R1,2	100k	2	(M100K)
R3,6,9, 10,13, 14,17,18	1M8	8	(M1M8)
R4,5	3k9	2	(M3K9)
R7,8,11, 12,15, 16,19,20	15k	8	(M15K)
RV1,2,3,4	100k Linear Potentiometer	4	(FW05V)

CAPACITORS

C1	100μF 10V PC Electrolytic	1	(FF10L)
C2	1μF 100V PC Electrolytic	1	(FF01B)
C3	22μF 25V PC Electrolytic	1	(FF06G)
C4	4n7F Polyester	1	(WW26D)
C5	47nF Polyester	1	(WW37S)
C6	1nF Polyester	1	(WW22Y)
C7	10nF Polyester	1	(WW29G)
C8	220pF Polystyrene	1	(BX30H)
C9	2n2F Polyester	1	(WW24B)
C10	47pF Polystyrene	1	(BX26D)
C11	470pF Polystyrene	1	(BX32K)
C12	10μF 50V PC Electrolytic	1	(FF04E)

SEMICONDUCTORS

IC1	μA741C	1	(QL22Y)
IC2,3	MC1458CN	2	(QH46A)

MISCELLANEOUS

JK1,2	Standard ¼in. Jack	2	(HF91Y)
S1	SPST Ultra-Miniature Toggle Switch	1	(FH97F)
B1	PP3 Size Battery	1	(FK58N)
	PP3 Battery Connector	1	(HF28F)
	8-Pin DIL IC Socket	3	(BL17T)

AUDIO/VISUAL METRONOME

RESISTORS: All 0·6W 1% Metal Film (Unless specified)

R1	47k	1	(M47K)
R2	3k3	1	(M3K3)
R3,4	1k	2	(M1K)
R5,6	5k6	2	(M5K6)
R7	56k	1	(M56K)
RV1	470k Linear Potentiometer	1	(FW07H)

CAPACITORS

C1,5	100μF 10V PC Electrolytic	2	(FF10L)
C2	47nF Polyester	1	(WW37S)
C3	330pF Ceramic	1	(WX62S)
C4	4n7F Polyester	1	(WW26D)

SEMICONDUCTORS

IC1	TS555CN	1	(RA76H)
IC2	4024BE	1	(QX13P)
IC3	NE555N	1	(QH66W)
D1,2	10mm Red LED	2	(UK28F)

MISCELLANEOUS

S1	SPST Miniature Toggle Switch	1	(FH97F)
LS1	77mm Diameter 8Ω Speaker	1	(YW53H)
B1	AA (HP7) Size Cells	6	(FK64U)
	Battery Clip	1	(HF28F)
	6 3 AA Battery Holder	1	(HQ01B)
	8-Pin DIL IC Socket	2	(BL17T)
	14-Pin DIL IC Socket	1	(BL18U)

MODEL TRAIN SIGNAL LIGHTS

RESISTORS: All 0·6W 1% Metal Film

R1,6	10k	2	(M10K)
R2	2M2	1	(M2M2)
R3,4,5	1k	3	(M1K)
R7	5k6	1	(M5K6)
R8	2k2	1	(M2K2)

CAPACITORS

C1	100μF 25V PC Electrolytic	1	(FF11M)
C2	1μF 100V PC Electrolytic	1	(FF01B)
C3	100nF Polyester	1	(WW41U)

SEMICONDUCTORS

IC1	NE555N	1	(QH66W)
IC2	4017BE	1	(QX09K)
IC3	4013BE	1	(QX07H)
D1	Green LED	1	(WL28F)
D2	Red LED	1	(WL27E)
D3	Orange LED	1	(WL29G)
D4	1N4148	1	(QL80B)

MISCELLANEOUS

S1	Miniature Reed Switch	1	(FX70M)
	Magnet	1	(FX72P)
	8-Pin DIL Socket	1	(BL17T)
	14-Pin DIL Socket	1	(BL18U)
	16-Pin DIL Socket	1	(BL19V)

GO/NO GO THYRISTOR TESTER

RESISTORS: All 0·6W 1% Metal Film

R1	2M2	1	(M2M2)
R2,R3	3k3	2	(M3K3)
R4	820Ω	1	(M820R)

CAPACITORS

C1	100nF Polyester	1	(BX76H)
C2	1μF 100V Electrolytic	1	(FB12N)

SEMICONDUCTORS

LD1	5mm Red	1	(WL27E)
IC1	CMOS 4001	1	(QX01B)
IC2	CMOS 4017	1	(QX09K)
TR1	BC107	1	(QB31J)

MISCELLANEOUS

S1	Push to Make Switch	1	(FH59P)
B1	PP3 9V Battery	1	(FK58N)
	Battery Clip	1	(HF28F)
	14-Pin DIL Socket	1	(BL18U)
	16-Pin DIL Socket	1	(BL19V)
	Red Crocodile Clip	1	(FM37S)
	Black Crocodile Clip	1	(FK34M)
	Yellow Crocodile Clip	1	(FK35Q)

SOIL MOISTURE TESTER

RESISTORS: All 0·6W 1% Metal Film

R1,R2,R5	10k	3	(M10K)
R3	68k	1	(M68K)
R4	330k	1	(M330K)
RV1	10k Linear	1	(JM71N)

CAPACITORS

C1	1μF 100V Electrolytic	1	(FB12N)
C2	100nF Polyester	1	(CX21X)
C3	100μF 10V Electrolytic	1	(FB48C)

SEMICONDUCTORS

IC1	TL082	1	(RA71N)

MISCELLANEOUS

S1	Push to Make Switch	1	(FH59P)
B1	PP3 9V Battery	1	(FK58N)
	Battery Clip	1	(HF28F)
LS1	64Ω 0·1W	1	(YT27E)
	8-Pin DIL Socket	1	(BL17T)
	6BA 3 1in. Bolt	2	(BF07H)
	6BA Solder Tags	2	(BF29G)
	6BA Nuts	4	(BF18U)

The circuits and information presented here must be considered as a basis for your own experimentation. No warranty is given for suitability in particular applications, reliability or circuit operation. Maplin cannot support, in any way, the information presented here. However, where possible, we will endeavour to check that information presented is correct, and that circuits will function as stated.

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BATTERIES

Zinc Carbon General Purpose

Panasonic

A basic form of zinc carbon battery, having a positive electrode of manganese dioxide and a negative electrode of zinc. Offers value for money performance in not too demanding applications.

Characteristics

Type	Mass	Nominal capacity
AA	18g	1Ah at 75Ω for 4h/day to 0.7V
C	48g	1.9Ah at 75Ω for 4h/day to 0.8V
D	98g	5.2Ah at 39Ω for 4h/day to 0.8V

Order Code	Type	Price each exc. Vat 6769			inc. Vat
		1+	10+	25+	1+
51338	Zinc Carbon AA x 4	£1.270	£0.990	£0.909	£1.500
51339	Zinc Carbon C x 2	£1.270	£0.990	£0.909	£1.500
51340	Zinc Carbon D x 2	£1.270	£0.990	£0.909	£1.500

Zinc Chloride

Panasonic

A range of batteries with an electrolyte of zinc chloride used with mangenese dioxide and zinc electrodes. Suited to heavier duty, high drain applications and are also 'environmentally friendlier'.

Characteristics

Type	Mass	Nominal capacity
Ultra AAA	9·7g	568mAh at 75Ω for 4h/day to 0·9V
Ultra AA	19g	1·0Ah at 75Ω for 4h/day to 0·9V
Ultra C	51·5g	2·8Ah at 75Ω for 4h/day to 0·8V
Ultra D	100g	7·2Ah at 39Ω for 4h/day to 0·8V
PP3	38g	0·38Ah at 900Ω for 4h/day to 5·5V

Order Code	Type	Price each exc. Vat 6741			inc. Vat
		1+	10+	25+	1+
51341	Zinc Chloride AAAx4	£1.690	£1.340	£1.220	£1.990
51342	Zinc Chloride AA x 4	£1.710	£1.350	£1.230	£2.010
51343	Zinc Chloride C x 2	£1.710	£1.350	£1.230	£2.010
51344	Zinc Chloride D x 2	£1.710	£1.350	£1.230	£2.010
51345	Ultra Power PP3	£1.620	£1.230	£1.130	£1.910

Lighting and General Purpose

Zinc carbon batteries for a wide range of general-purpose and miscellaneous applications, such as doorbells and burglar alarms, etc.

Voltage	Dimensions (mm)	Type	Terminals
3V	21·8 dia. x 74·6 high	No.8	Stud
4·5V	62 x 22 x 67 high	312G	Flat Spring
4·5V	103 x 35 x 92 high	126	Screw
6V	67 x 67 x 102 high	908S	Coiled Spring
6V	137 x 73 x 127 high	918S	Screw
6V	67 x 67 x 110 high	HP992	Screw

Technical Information

Type	Mass	Nominal capacity
No.8	42·5g	1·12Ah at 300Ω for 4 hours/day to 1·8V
312G	113g	2·3Ah at 225Ω for 4 hours/day to 2·7V
126	369g	5·76Ah at 75Ω for 4 hours/day to 2·7V
908S	600g	6·4Ah at 8·2Ω for 30 mins/day to 3·6V
918S	1080g	15Ah at 10Ω for 30 mins/day to 3·6V
HP992	581g	6·19Ah at 10Ω for 30 mins/day to 3·6V

Order Code	Type	Price each exc. Vat 39			inc. Vat
		1+	20+	100+	1+
51346	Gen Purpose No.8	£0.851	£0.707	£0.651	£1.000
51347	312G Battery	£0.944	£0.768	£0.687	£1.110
51348	Gen Purpose 126	£3.420	£3.080	£2.920	£4.030
51351 2	Gen Purpose HP992	£6.000	£5.170	£4.800	£7.060

Order Code	Type	Price each exc. Vat 39			inc. Vat
		1+	12+	48+	1+
51349 1	908S	£2.740	£2.120	£1.770	£3.220
51350 2	918S	£4.280	£3.640	£3.280	£5.040
51351 2	Gen Purpose HP992	£6.000	£5.170	£4.800	£7.060

Sealed Nickel Cadmium Batteries

Nickel cadmium (NiCd) cells will replace dry batteries in most medium and high current applications. They are very economical in applications where dry batteries constantly need replacing. They must be recharged using special constant current chargers but, even if the cost of the charger is added to the cost of the batteries, they still show a considerable saving over dry batteries after just a few changes. NiCd cells are not suitable for use in very low-power applications such as clocks, or any similar application where a dry cell would only need replacing infrequently.

All the batteries in the range should have a minimum life of at least 500 full charge/discharge cycles. Providing that the charge rate never exceeds the maximum current stated and the discharge rate never exceeds twice the current, the life should be around 3,000 full charge/discharge cycles. Cells may be charged at any current up to the maximum stated, but will take progressively longer to charge at lower currents. No harm will result if the cells are charged for longer periods.

Cell size	Nominal capacity (mAh)	Dimensions Dia. x Height (mm)	Weight (g)	Standard charge for 14 hours (mA)
AAA	240	10·5 x 44·5	10	24
AA	500	14·6 x 50·0	19	50
AA	650	14·6 x 50·0	22	65
C	1500	26·2 x 50·0	40	150
D	1500	34·2 x 61·5	50	160
PP3	110	48 x 25 x 16	45	12

Note: The 500mAh AA size is available singly or in a pack of four.

Order Code	Type	Price each exc. Vat 6745			inc. Vat
		1+	10+	25+	1+
51352	NiCad 500 AA x 1	£1.370	£1.060	£0.909	£1.610

Order Code	Type	Price each exc. Vat 6745			inc. Vat
		1+	10+	25+	1+
51353	NiCad 240 AAAx4	£6.000	£4.750	£4.340	£7.060
51354	NiCad 500 AAx4	£4.970	£3.990	£3.690	£5.850
51355	NiCad 650 AAx4	£5.400	£4.700	£4.290	£6.350
51356	NiCad 1500 Cx2	£5.140	£4.240	£3.990	£6.050
51357	NiCad 1500 Dx2	£5.140	£4.240	£3.990	£6.050
51358	NiCad 110 PP3	£5.830	£5.000	£4.650	£6.860

In the following list of industrial sizes and capacities three 'tagged' versions of standard cells are available. These have solder tags for making up rechargeable battery packs. EM27E is a tagged version of AG16S, AA. AG21X and JF99H are tagged versions of AG22Y SUB-C.

Order Code	Cell size	Nominal capacity (mAh)	Dimensions Dia. x Height (mm)	Weight (g)	Standard charge for 14 hours (mA)
AQ47B	N	150	12·0 x 29·0	8	15
AG11M	1/3AA	130	14·6 x 16·7	6	13
AG12N	2/3AA	400	14·6 x 28·2	12	40
AG17T	7/5AA	1100	14·6 x 66·0	30	110
AG16S	AA	850	14·6 x 50·0	25	85
EM27E	AA Tagged	850	14·6 x 50·0	25	85
AG15R	2/3AF	700	17·0 x 29·0	18	70
AG18U	4/5AF	1200	17·0 x 43·0	28	120
AG24B	7/5AF	2000	17·2 x 66·0	43	200
AG23A	AF	1400	17·0 x 50·0	33	140
AG19V	C	2000	26·0 x 50·0	45	200
AG22Y	SUB-C	1200	22·7 x 42·1	55	120
AG21X	SUB-CTagged	1200	22·7 x 42·1	55	120
JF99H	SUB-CTagged	1800	22·7 x 42·1	55	120
AG20W	D	4000	33·0 x 61·0	55	400

Order Code	Type	Price each exc. Vat 6745			inc. Vat
		1+	25+	100+	1+
51359	N 150	£1.960	£1.480	£1.360	£2.310
51360	1/3AA 130	£1.100	£0.899	£0.788	£1.300
51361	2/3AA 400	£1.270	£1.030	£0.909	£1.500
51362	7/5AA 1100	£2.400	£2.120	£1.870	£2.820
51363	2/3AF 700	£1.450	£1.160	£1.060	£1.710
51364	4/5AF 1200	£2.400	£1.620	£1.360	£2.820
51365	7/5AF 2000	£3.680	£3.030	£2.630	£4.330
51366	AF 1400	£2.570	£2.020	£1.720	£3.020
51367	C 2000	£3.940	£3.280	£3.130	£4.640
51368	SUB-C 1200	£2.130	£1.770	£1.620	£2.510
51369	SUB-C 1200 Tagged	£2.310	£1.920	£1.670	£2.720
51370	SUB-C 1800 Tagged	£3.250	£2.410	£2.150	£3.830
51371	D 4000	£5.140	£3.990	£3.690	£6.050

Order Code	Type	Price each exc. Vat 6745			inc. Vat
		1+	10+	25+	1+
51372	AA 850	£1.710	£1.260	£1.110	£2.010
51373	NiCd AA 850 Tagged	£1.880	£1.460	£1.310	£2.210

CHARGERS

Universal Charger

A nickel-cadmium battery charger capable of charging AAA, AA, C, D, PP3 and rechargeable button cells singly or simultaneously in numerous combinations. There are two charge sockets for PP3 batteries and either one or two may be charged together. There are two positions where AAA or AA cells may be charged and four positions where AA, C or D cells may be charged. In addition there are two positions for rechargeable button cells, diameters 16mm, 11·6mm or 8mm. All ten charge positions may be used simultaneously or in any combination.

Each of the eight main charge positions (i.e. not the button cells) has an LED associated with it which lights when charging is in progress. In addition three test positions are provided, one for AAA and AA, one for C and D cells and one for PP3 batteries. When the charging switch is off, depressing the test button for the test position in use allows the meter to show if the battery is flat. The unit has 1·7m mains lead. Overall size: 185 x 155 x 56mm.

Charge rates for full charge

AAA in position marked UM3,4,5	5 to 7 hours
AA in position marked UM3,4,5	13 to 17 hours
AA in position marked UM1,2,3	5 to 7 hours
C Commercial	13 to 17 hours
C Industrial	22 to 28 hours
D Commercial	13 to 17 hours
D Industrial	45 to 55 hours
Button cells	5 to 7 hours
PP3	11 to 13 hours (20 hours max)

Note that of the 6 positions for AA cells, four will give a fast charge and two a standard charge.

This charger must ONLY be used with rechargeable cells and batteries. It must NOT be used to charge silver oxide, zinc-air, mercuric oxide, alkaline, zinc-chloride or zinc-carbon cells.

Order Code	Type	Price each exc. Vat 214			inc. Vat
		1+	10+	25+	1+
51374 1	Deluxe Nicad Charger	£12.020	£9.090	£8.280	£14.130

Standard Charger

A nickel-cadmium battery charger capable of charging between 1 and 4 AA, C or D cells singly or simultaneously in any combination. In addition one PP3-size ni-cad can also be charged. Five LEDs are provided which light to show which charge positions are in use. Also one position may be used to test the cells (not PP3). With the cell in this position throw the switch provided to 'test' and the strength of glow of a special lamp shows the cell condition. If the lamp fails to glow or is very dim, charge the cell fully. If the lamp shines strongly the cell is charged. The unit has 1·7m mains lead. Overall size: 214 x 108 x 56mm.

Charge rates for full charge

AA	14 to 16 hours
C Commercial	20 to 25 hours
C Industrial	35 to 40 hours
D Commercial	20 to 25 hours
D Industrial	70 to 75 hours
PP3	14 to 16 hours (24 hours max)

This charger must ONLY be used with rechargeable cells and batteries.

Order Code	Type	Price each exc. Vat 213			inc. Vat
		1+	10+	25+	1+
51375 1	Ni-Cad Charger	£7.720	£5.960	£5.250	£9.080

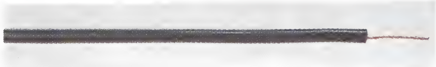
CABLES

Euro Socket to 13A Plug Lead

Moulded, high quality plug and socket non-rewirable cable assembly 2m long and rated at 5A 250V AC. The plug is supplied with a 5A fuse. Colour black.

Order Code	Type	Price each exc. Vat 1176			inc. Vat
		1+	25+	100+	1+
51376	Euro-3Pin Lead	£3.420	£2.830	£2.420	£4.030

Extra-Flexible Wire



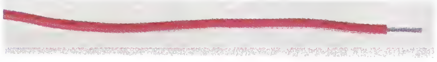
A very flexible wire ideal for test leads, and as inter-connection wires which are frequently being moved.

Stranded core, single:	55/0·1mm copper
Sheath:	1mm very flexible PVC
Overall diameter:	2·8mm
Nom. conductor area:	0·43mm²
Max. working voltage:	650V DC, 500V AC
Max current:	2·5A
Colours:	Black, Blue, Green, Red

Sold per metre (max. length in one piece 25m) and on 25m reels.

Order Code	Type	Price each exc. Vat 6203			inc. Vat
		1+	5+	10+	1+
51377	Extra Flex Black	£0.204			£0.240
51378	25m Extra Flex Black	£3.250	£2.890	£2.750	£3.830
51379	Extra Flex Blue	£0.204			£0.240
51380	25m Extra Flex Blue	£3.250	£2.890	£2.750	£3.830
51381	Extra Flex Green	£0.204			£0.240
51382	25m Extra Flex Green	£3.250	£2.890	£2.750	£3.830
51383	Extra Flex Red	£0.204			£0.240
51384	25m Extra Flex Red	£3.250	£2.890	£2.750	£3.830

Hook-Up Wire (16/0·2)



A flexible wire for general purpose and heavy duty interconnections within apparatus.

Stranded core, single: 16/0·2mm copper
Sheath: 0·3mm PVC – conforms to DEF61-12 (part 6) Type 2
Overall diameter: 1·6mm
Nom. conductor area: 0·5mm²
Max. working voltage: 1000V rms
Max. current: 3A
Colours: Black, Blue, Brown, Green, Orange, Red, White, Yellow.

In 10m approx packs and 100m reels.

Order Code		Type	Price each exc. Vat 6197			inc. Vat
			1+	5+	10+	1+
51385		16/0.2 Wire 10M Blk	£0.842			£0.990
51386	1	100m 16/0.2 Wire Blk	£6.000	£5.250	£4.950	£7.060
51387		16/0.2 Wire 10M Blu	£0.842			£0.990
51388	1	100m 16/0.2 Wire Blu	£6.000	£5.250	£4.950	£7.060
51389		16/0.2 Wire 10M Brn	£0.842			£0.990
51390	1	100m 16/0.2 Wire Brn	£6.000	£5.250	£4.950	£7.060
51391		16/0.2 Wire 10M Grn	£0.842			£0.990
51392	1	100m 16/0.2 Wire Grn	£6.000	£5.250	£4.950	£7.060
51393		16/0.2 Wire 10M Orn	£0.842			£0.990
51394	1	100m 16/0.2 Wire Orn	£6.000	£5.250	£4.950	£7.060
51395		16/0.2 Wire 10M Red	£0.842			£0.990
51396	1	100m 16/0.2 Wire Red	£6.000	£5.250	£4.950	£7.060
51397		16/0.2 Wire 10M Wht	£0.842			£0.990
51398	1	100m 16/0.2 Wire Wht	£6.000	£5.250	£4.950	£7.060
51399		16/0.2 Wire 10M Yel	£0.842			£0.990
51400	1	100m 16/0.2 Wire Yel	£6.000	£5.250	£4.950	£7.060

Enamelled Copper Wire

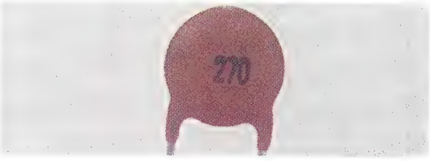
A 50g roll of Grade 1 enamelled copper wire. Available in the following diameter sizes mm (approx. swg): 2·0 (14), 1·6 (16), 1·25 (18), 0·9 (20), 0·71 (22), 0·56 (24), 0·45 (26), 0·375 (28), 0·315 (30), 0·28 (32), 0·236 (34), 0·19 (36), 0·15 (38), 0·125 (40), 0·1 (42), and 0·08 (44). All sizes up to 0·125mm (40swg) also available on 250g reels.
Breakdown 7KVA Tested to IEC 851/5/4
Approx. length of wire per reel.

Gauge (mm)	Reel size		Gauge (mm)	Reel size	
	50g	250g		50g	250g
2·0	1·75m	8·75m	0·315	70m	350m
1·6	2·7m	13·5m	0·28	95m	475m
1·25	4·8m	24m	0·236	130m	650m
0·9	8·5m	42·5m	0·19	190m	950m
0·71	14m	70m	0·15	300m	1500m
0·56	22·5m	112m	0·125	440m	2200m
0·45	34m	170m	0·1	680m	–
0·375	50m	250m	0·08	1050m	–

Order Code	Type	Price each exc. Vat 44		inc. Vat
		1+	10+	1+
51401	EC Wire 2.0mm 14swg	£0.851	£0.754	£1.000
51402	250 ECW 2.0mm 14swg	£2.680	£2.330	£3.150
51403	EC Wire 1.6mm 16swg	£0.851	£0.754	£1.000
51404	250 ECW 1.6mm 16swg	£2.680	£2.330	£3.150
51405	EC Wire 1.25mm 18swg	£0.851	£0.754	£1.000
51406	250 ECW 1.25mm 18swg	£2.730	£2.370	£3.210
51407	EC Wire 0.9mm 20swg	£0.851	£0.754	£1.000
51408	250 ECW 0.9mm 20swg	£2.730	£2.370	£3.210
51409	EC Wire 0.71mm 22swg	£0.902	£0.786	£1.060
51410	250 ECW 0.71mm 22swg	£2.820	£2.450	£3.320
51411	EC Wire 0.56mm 24swg	£0.902	£0.786	£1.060
51412	250 ECW 0.56mm 24swg	£2.910	£2.510	£3.420
51413	EC Wire 0.45mm 26swg	£0.936	£0.816	£1.100
51414	250 ECW 0.45mm 26swg	£2.960	£2.580	£3.480
51415	EC Wire 0.375mm28swg	£0.936	£0.816	£1.100
51416	250 ECW 0.375mm28swg	£2.990	£2.610	£3.520
51417	EC Wire 0.315mm30swg	£0.936	£0.816	£1.100
51418	250 ECW 0.315mm30swg	£3.050	£2.660	£3.590
51419	EC Wire 0.28mm 32swg	£0.936	£0.816	£1.100
51420	250 ECW 0.28mm 32swg	£3.080	£2.750	£3.630
51421	EC Wire 0.236mm34swg	£0.987	£0.878	£1.160
51422	250 ECW 0.236mm34swg	£3.170	£2.840	£3.730
51423	EC Wire 0.19mm 36swg	£0.987	£0.878	£1.160
51424	250 ECW 0.19mm 36swg	£3.420	£3.090	£4.030
51425	EC Wire 0.15mm 38swg	£0.987	£0.878	£1.160
51426	250 ECW 0.15mm 38swg	£3.680	£3.160	£4.330
51427	EC Wire 0.125mm40swg	£1.070	£0.958	£1.260
51428	250 ECW 0.125mm40swg	£3.850	£3.360	£4.530

CAPACITORS

Metallised Ceramic Plate Capacitors



A miniature ceramic capacitor with a cementcoated case. Values up to and including 220pF are suitable for temperature compensation in tuned circuits where low losses, close tolerance and high stability are required. Values from 270pF to 4700pF are suitable for use in coupling and decoupling applications, where a non-linear change of capacitance with temperature is permissible. Values 10,000pF and 22,000pF are suitable for use in coupling and decoupling applications, where capacitance stability is not critical.

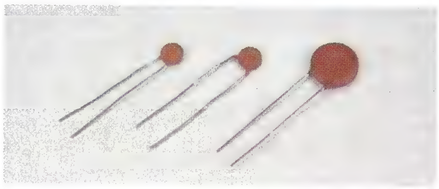
Specification

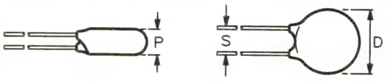
Tolerance:
1·8pF to 4.7pF: ±0·25pF
5.6pF to 330pF: ±5%
390pF to 4700pF: ±10%
10,000pF and 22,000pF: -20% +80%
Working voltage:
1·8pF to 4700pF: 100V DC
10,000pF and 22,000pF: 63V DC
Insulation resistance: >1000MΩ
Temperature coefficient:
1·8pF to 220pF: Zero
270pF to 390pF: +350 to -1000ppm/°C
470pF to 4700pF: medium K (±10%)
10,000pF to 20,000pF: high K (+22% -82%)
Power factor:
1·8pF to 390pF: $<10x10^{-4}$
470pF to 4700pF: $<25x10^{-3}$
10,000pF: $<50x10^{-2}$
22,000pF: $<25x10^{-2}$
Dimensions
Thickness of body: 2·25mm max.
Lead spacing: 5mm
Lead length: 25mm

Capacitance (pF)	Diameter (mm) max.	Capacitor marking
1·8	5	1·8C
2·2	5	2·2C
2·7	5	2·7C
3·3	5	3·3C
3·9	5	3·9C
4·7	5	4·7C
5·6	5	5·6
6·8	5	6·8
8·2	5	8·2
10	5	10J
12	5	12J
15	5	15J
18	5	18J
22	5	22J
27	5	27J
33	5	33J
39	6	39J
47	6	47J
56	6	56J
68	7	68J
82	7	82J
100	7	101J NPO
120	8	121J
150	8	151J NPO
180	8	181J NPO
220	10	221J NPO
270	8	270
330	7	330
390	9	391K
470	5	471K
560	5	561K
680	5	681K
820	5	821K
1000	5	102K
1200	5	122
1500	5	152
1800	5	182
2200	5	222
2700	6	272
3300	7	332
3900	7	392
4700	8	472K
10,000	6	103Z
22,000	7	223Z

Order Code	Type	Price each exc. Vat 304			inc. Vat
		1+	25+	100+	1+
51431	Ceramic 1.8	£0.076	£0.063	£0.046	£0.090
51432	Ceramic 2.2	£0.076	£0.063	£0.046	£0.090
51433	Ceramic 2.7	£0.076	£0.063	£0.046	£0.090
51434	Ceramic 3.3	£0.076	£0.063	£0.046	£0.090
51435	Ceramic 3.9	£0.076	£0.063	£0.046	£0.090
51436	Ceramic 4.7	£0.076	£0.063	£0.046	£0.090
51437	Ceramic 5.6	£0.076	£0.063	£0.046	£0.090
51438	Ceramic 6.8	£0.076	£0.063	£0.046	£0.090
51439	Ceramic 8.2	£0.076	£0.063	£0.046	£0.090
51440	Ceramic 10	£0.076	£0.063	£0.046	£0.090
51441	Ceramic 12	£0.076	£0.063	£0.046	£0.090
51442	Ceramic 15	£0.076	£0.063	£0.046	£0.090
51443	Ceramic 18	£0.076	£0.063	£0.046	£0.090
51444	Ceramic 22	£0.076	£0.063	£0.046	£0.090
51445	Ceramic 27	£0.076	£0.063	£0.046	£0.090
51446	Ceramic 33	£0.076	£0.063	£0.046	£0.090
51447	Ceramic 39	£0.076	£0.063	£0.046	£0.090
51448	Ceramic 47	£0.076	£0.063	£0.046	£0.090
51449	Ceramic 56	£0.085	£0.073	£0.055	£0.100
51450	Ceramic 68	£0.085	£0.073	£0.055	£0.100
51451	Ceramic 82	£0.085	£0.073	£0.055	£0.100
51452	Ceramic 100	£0.085	£0.073	£0.055	£0.100
51453	Ceramic 120	£0.085	£0.073	£0.055	£0.100
51454	Ceramic 150	£0.085	£0.073	£0.055	£0.100
51455	Ceramic 180	£0.085	£0.073	£0.055	£0.100
51456	Ceramic 220	£0.085	£0.073	£0.055	£0.100
51457	Ceramic 270	£0.085	£0.073	£0.055	£0.100
51458	Ceramic 330	£0.085	£0.073	£0.055	£0.100
51459	Ceramic 390	£0.085	£0.073	£0.055	£0.100
51460	Ceramic 470	£0.085	£0.073	£0.055	£0.100
51461	Ceramic 560	£0.085	£0.073	£0.055	£0.100
51462	Ceramic 680	£0.085	£0.073	£0.055	£0.100
51463	Ceramic 820	£0.085	£0.073	£0.055	£0.100
51464	Ceramic 1000	£0.085	£0.073	£0.055	£0.100
51465	Ceramic 1200	£0.085	£0.073	£0.055	£0.100
51466	Ceramic 1500	£0.085	£0.073	£0.055	£0.100
51467	Ceramic 1800	£0.085	£0.073	£0.055	£0.100
51468	Ceramic 2200	£0.085	£0.073	£0.055	£0.100
51469	Ceramic 2700	£0.093	£0.080	£0.058	£0.110
51470	Ceramic 3300	£0.093	£0.080	£0.058	£0.110
51471	Ceramic 3900	£0.093	£0.080	£0.058	£0.110
51472	Ceramic 4700	£0.093	£0.080	£0.058	£0.110
51473	Ceramic 10,000	£0.093	£0.080	£0.058	£0.110
51474	Ceramic 22,000	£0.093	£0.080	£0.058	£0.110

Ceramic Disc





General purpose cement-coated ceramic disc capacitor having a large capacitance in a very small case size.
Tolerance: –20+80%
Power factor: <8% at 1kHz

Value (µF)	Voltage (V DC)	Diameter (mm)	Thickness (mm)	Lead pitch (mm)
0·01	50	5	4	2·5
0·022	50	7	4	2·5
0·047	16	9	4	5
0·047	50	9	4	5
0·1	16	10	4	5
0·1	50	10	4	5
0·22	16	10	4	5
0·22	25	10	4	5

Order Code	Type	Price each exc. Vat 318			inc. Vat
		1+	25+	100+	1+
51475	Disc 0.01uF 50V	£0.093	£0.055	£0.044	£0.110
51476	Disc 0.022uF 50V	£0.093	£0.055	£0.044	£0.110
51477	Minidisc 0.047uF 16V	£0.093	£0.055	£0.044	£0.110
51478	Disc 0.047uF 50V	£0.093	£0.055	£0.044	£0.110
51479	Minidisc 0.1uF 16V	£0.136	£0.080	£0.060	£0.160
51480	Disc 0.1uF 50V	£0.212	£0.115	£0.085	£0.250
51481	Minidisc 0.22uF 16V	£0.212	£0.115	£0.085	£0.250
51482	Disc 0.22uF 25V	£0.212	£0.115	£0.085	£0.250

High Voltage Metallised Polyester Film

Conis

A range of high voltage,metallised polyester film capacitors that are suitable for a wide range of applications including supply decoupling, filter, integrator and audio circuits etc. These low-cost, non-inductive, self-healing capacitors conform to IEC 384-1/384-2.

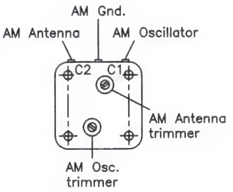
Specification

Tolerance:	±10%
Dissipation factor:	tan∂≤100 x 10^{-4}/1kHz
Insulation resistance	
≤0.33μF:	10^4MΩ
>0.33μF:	10^3MΩ

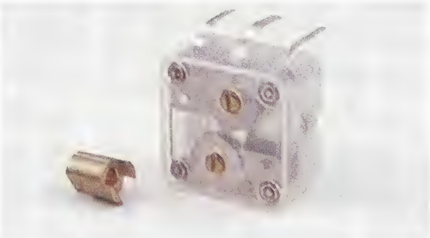
Value μF	Voltage V DC	Dimensions mm l	h	w	p	Order Code
0.01	630	15	8.2	5	12.5	DS81C
0.022	630	15	8.5	5	12.5	DS82D
0.047	630	20	10.6	6	17.5	DS83E
0.1	250	15	9	5.4	12.5	DS84F
0.1	400	20	11.4	6	17.5	DS85G
0.1	630	20	12	7.3	17.5	DS86T
0.22	400	25	13.5	9	22.5	DS87U
0.47	250	25	12	6.5	22.5	DS88V
1.0	250	25	15	9	22.5	DS89W
2.2	250	35	19	9	32.5	DS90X

Order Code	Type	Price each exc. Vat 12032 1+	25+	100+	inc. Vat 1+
51483	0.01 Polyester 630V	£0.136	£0.100	£0.085	£0.160
51484	0.022 Polyester 630V	£0.136	£0.100	£0.085	£0.160
51485	0.047 Polyester 630V	£0.144	£0.110	£0.095	£0.170
51486	0.1 Polyester 250V	£0.153	£0.115	£0.095	£0.180
51487	0.1 Polyester 400V	£0.204	£0.150	£0.125	£0.240
51488	0.1 Polyester 630V	£0.263	£0.190	£0.160	£0.310
51489	0.22 Polyester 400V	£0.280	£0.210	£0.175	£0.330
51490	0.47 Polyester 250V	£0.272	£0.200	£0.170	£0.320
51491	1.0 Polyester 250V	£0.340	£0.255	£0.210	£0.400
51492	2.2 Polyester 250V	£0.493	£0.375	£0.325	£0.580

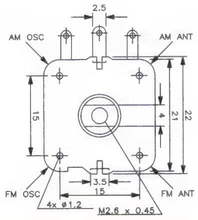
AM/FM Miniature Tuning Capacitors



Drawing of FT78K



Miniature tuning capacitors for radios, ZN416 circuits and crystal sets. Each has an antenna section and an oscillator section for each band, and a trimmer for each section. The control shaft is a flatted 6mm dia. brass spindle, tapped down the centre with an M2.5 thread. Fixing is either direct pcb or by two M2.5 screws on 14mm centres on same face as shaft. (Note: Thread length is 3mm. If using long screws, take care that they do not foul the vanes.)



Drawing of AB11M

Specifications:

For stock code:	**AB11M**	**FT78K**
Capacity AM sections:	126pF	141.6/59.2pF*
Capacity FM sections:	20pF	-
Q AM sections:	<500	500
Q FM sections:	<150	-
Total rotation:	180°	180°
Max voltage:	100V	100V
Dimensions mm: (excluding shaft)	20x20x13	20x20x13

*Antenna/Oscillator gang.

Order Code	Type	Price each exc. Vat 463 1+	25+	100+	inc. Vat 1+
51493	Mini AM FM Tuner	£1.520	£1.050	£0.900	£1.790
51494	Min AM Tuner Cap	£1.260	£0.950	£0.750	£1.490

Multilayer Metallised Polyester Film

Conis

A range of multilayer metallised polyester film capacitors that are epoxy resin sealed in a flame-retardant thermoplastic case (UL94VO).
These low-cost capacitors have a high CV to volume ratio and are highly reliable and stable over a very wide temperature range (-5°C to +100°C). The capacitors are non-inductive with a standard 5mm lead spacing and are primarily intended for PCB mounting. Conform to IEC 384-1/384-2 and CECC 30000/30400.

Specification

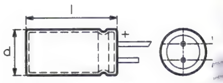
Voltage working:	63V DC
Tolerance:	±10%
Dissipation factor:	tan ∂≤0.01/1kHz typical 50 x 10^{-4}

Value nF	Dimensions mm length	height	width	Order Code
1	7.5	6.5	2.5	DT92A
2.2	7.5	6.5	2.5	DT93B
4.7	7.5	6.5	2.5	DT94C
10	7.5	6.5	2.5	DT95D
22	7.5	6.5	2.5	DT96E
47	7.5	6.5	2.5	DT97F
100	7.5	6.5	2.5	DT98G
220	7.7	8.5	5	DT99H
470	7.7	8.5	5	DS80B

Height does not include the length of the leads (6mm).

Order Code	Type	Price each exc. Vat 12031 1+	25+	100+	inc. Vat 1+
51495	1n Poly Film	£0.136	£0.090	£0.080	£0.160
51496	2.2n Poly Film	£0.136	£0.090	£0.080	£0.160
51497	4.7n Poly Film	£0.136	£0.090	£0.080	£0.160
51498	10n Poly Film	£0.136	£0.090	£0.080	£0.160
51499	22n Poly Film	£0.144	£0.095	£0.080	£0.170
51500	47n Poly Film	£0.153	£0.105	£0.090	£0.180
51501	100n Poly Film	£0.170	£0.120	£0.100	£0.200
51502	220n Poly Film	£0.272	£0.200	£0.165	£0.320
51503	470n Poly Film	£0.459	£0.330	£0.270	£0.540

Radial Electrolytics



Dimensions in mm

A range of small long life (2000H) electrolytic capacitors designed for direct mounting on PCBs.

Tolerance:	±20%
Temperature range:	–40°C to +85°C

Cap (μF)	Working Voltage (DC)	Case Size (mm) l (max)	d (max)	p	Leakage Current (μA max)	Power Factor (max)	Ripple current (mA max) at 120Hz 85°C
0·47	100	11	5	2	12	0·1	3·9
1	100	11	5	2	18	0·1	5
1	450	12.5	10	5	18	0·24	37
2·2	100	11	5	2	27	0·1	7·4
4·7	63	11	5	2	40	0·1	8·9
4·7	100	11	5	2	42	0·1	12·4
4·7	450	20	12.5	5	42	0·24	137
10	50	11	5	2	54	0·1	13
10	63	11	5	2	58	0·1	15·6
10	100	11	6·3	2.5	69	0·1	23
10	450	25	12.5	5	69	0·24	280
22	25	11	5	2	69	0·15	14
22	50	11	5	2·5	81	0·1	25
22	63	11	6·3	2·5	98	0·1	30·7
22	100	11.5	8	3·5	120	0·1	47
33	35	11	5	2·5	91	0·12	26·1
33	63	11	6·3	2·5	120	0·1	44·6
47	25	11	5	2	100	0·15	26·5
47	50	11	6·3	2·5	140	0·1	50
47	63	11.5	8	3·5	170	0·1	62·2
47	100	16	10	5	230	0·1	97
100	10	11	5	2	130	0·2	23
100	25	11	6·3	2·5	170	0·15	53
100	35	11.5	8	3·5	210	0·12	73
100	63	12.5	10	5	280	0·1	129
100	100	20	12.5	5	400	0·1	203
220	16	11.5	8	3·5	270	0·17	73·4
220	35	12.5	10	5	370	0·12	157
220	63	20	10	5	490	0·1	280
220	100	25	16	7·5	710	0·1	443
330	50	20	10	5	580	0·1	333
470	16	12.5	10	5	450	0·17	153
470	35	20	10	5	640	0·12	332
470	63	25	12.5	5	880	0·1	595
470	100	31.5	16	7·5	1100	0·1	943
1000	16	20	10	5	790	0·17	323
1000	35	25	12.5	5	1100	0·12	703
1000	63	31.5	16	7·5	1530	0·1	1263
1000	100*	40	18	7·5	1750	0·1	2003
2200	16	25	12.5	5	1340	0·2	707
2200	35	31.5	16	7·5	1810	0·15	1543
2200	63*	40	18	7·5	2350	0·13	2775
4700	16	31.5	16	7·5	2100	0·25	1507
4700	35*	25	25	10	2600	0·2	3293
10,000	16*	30	22.5	8	2800	0·35	3203

Order Code	Type	Price each exc. Vat 405 1+	25+	100+	inc. Vat 1+
51504	PC Elect 0.47uF 100V	£0.119	£0.075	£0.060	£0.140
51505	PC Elect 1uF 100V	£0.119	£0.075	£0.060	£0.140
51506	PC Elect 1uF 450V	£0.400	£0.300	£0.230	£0.470
51507	PC Elect 2.2uF 100V	£0.119	£0.075	£0.060	£0.140
51508	PC Elect 4.7uF 63V	£0.119	£0.075	£0.060	£0.140
51509	PC Elect 4.7uF 100V	£0.119	£0.075	£0.060	£0.140
51510	PC Elect 4.7uF 450V	£0.612	£0.460	£0.370	£0.720
51511	PC Elect 10uF 50V	£0.119	£0.075	£0.060	£0.140
51512	PC Elect 10uF 63V	£0.119	£0.075	£0.060	£0.140
51513	PC Elect 10uF 100V	£0.161	£0.090	£0.075	£0.190
51514	PC Elect 10uF 450V	£0.757	£0.580	£0.440	£0.890
51515	PC Elect 22uF 25V	£0.119	£0.075	£0.060	£0.140
51516	PC Elect 22uF 50V	£0.119	£0.075	£0.060	£0.140
51517	PC Elect 22uF 63V	£0.161	£0.090	£0.075	£0.190
51518	PC Elect 22uF 100V	£0.161	£0.090	£0.075	£0.190
51519	PC Elect 33uF 35V	£0.119	£0.075	£0.060	£0.140
51520	PC Elect 33uF 63V	£0.161	£0.090	£0.075	£0.190
51521	PC Elect 47uF 25V	£0.119	£0.075	£0.060	£0.140
51522	PC Elect 47uF 50V	£0.161	£0.090	£0.075	£0.190
51523	PC Elect 47uF 63V	£0.161	£0.090	£0.075	£0.190
51524	PC Elect 47uF 100V	£0.297	£0.220	£0.160	£0.350
51525	PC Elect 100uF 10V	£0.119	£0.075	£0.060	£0.140
51526	PC Elect 100uF 25V	£0.161	£0.090	£0.075	£0.190
51527	PC Elect 100uF 35V	£0.161	£0.090	£0.075	£0.190
51528	PC Elect 100uF 63V	£0.272	£0.220	£0.160	£0.320
51529	PC Elect 100uF 100V	£0.408	£0.325	£0.260	£0.480
51530	PC Elect 220uF 16V	£0.161	£0.090	£0.075	£0.190

51531	PC Elect 220uF 35V	£0.195	£0.125	£0.098	£0.230
51532	PC Elect 220uF 63V	£0.331	£0.245	£0.195	£0.390
51533	PC Elect 220uF 100V	£0.468	£0.340	£0.275	£0.550
51534	PC Elect 330uF 50V	£0.331	£0.245	£0.195	£0.390
51535	PC Elect 470uF 16V	£0.238	£0.160	£0.110	£0.280
51536	PC Elect 470uF 35V	£0.314	£0.240	£0.180	£0.370
51537	PC Elect 470uF 63V	£0.519	£0.390	£0.290	£0.610
51538	PC Elect 470uF 100V	£1.230	£0.920	£0.580	£1.450
51539	PC Elect 1000uF 16V	£0.314	£0.240	£0.180	£0.370
51540	PC Elect 1000uF 35V	£0.468	£0.340	£0.260	£0.550
51541	PC Elect 1000uF 63V	£0.782	£0.580	£0.465	£0.920
51542	PC Elect 1000uF 100V	£2.030	£1.600	£1.300	£2.390
51543	PC Elect 2200uF 16V	£0.595	£0.450	£0.300	£0.700
51544	PC Elect 2200uF 35V	£1.010	£0.780	£0.490	£1.190
51545	PC Elect 2200uF 63V	£1.430	£1.120	£0.990	£1.690
51546	PC Elect 4700uF 16V	£1.180	£0.920	£0.560	£1.390
51547	PC Elect 4700uF 35V	£1.570	£1.230	£0.840	£1.850
51548	PC Elect 10000uF 16V	£1.400	£1.070	£0.910	£1.650

VX Series Axial Electrolytic

Nichicon

A range of axial leaded capacitors with values from 1 to 4700μF at voltages of 10 to 450V. Load life of 2000h at 85°C. Operating temperatures of –40 to +85°C. Leakage current not more than 0·03CV or 4μA (whichever is greater).

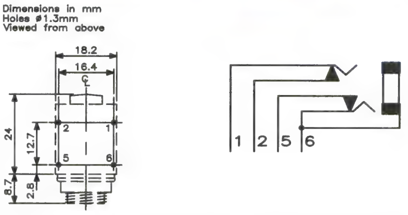
Capacitance μF	Working Voltage (VDC)	Part Number	Dimensions (dia x height) (mm)	Order Code
1	100	TVX2A010MAA	5 x 12	AT00A
2·2	100	TVX2A2R2MAA	5 x 12	AT01B
10	25	TVX1E100MAA	5 x 12	AT02C
10	63	TVX1J100MAA	5 x 12	AT03D
22	63	TVX1J220MAA	6·3 x 12	AT04E
47	16	TVX1C470MAA	5 x 12	AT05F
47	63	TVX1J470MAA	8 x 16	AT06G
47	450	TVX2W470MDA	22 x 40	AT07H
100	10	TVX1A101MAA	6·3 x 12	AT08J
100	35	TVX1V101MAA	8 x 16	AT09K
100	63	TVX1J101MAA	8 x 20	AT10L
220	16	TVX1C221MAA	8 x 16	AT11M
220	35	TVX1V221MAA	8 x 20	AT12N
470	10	TVX1A471MAA	8 x 16	AT13P
470	16	TVX1C471MAA	8 x 20	AT14Q
470	25	TVX1E471MCA	10 x 26	AT15R
470	63	TVX1J471MCA	13 x 31·5	AT16S
1000	10	TVX1A102MCA	10 x 21	AT17T
1000	16	TVX1C102MCA	10 x 26	AT18U
1000	35	TVX1V102MCA	13 x 31·5	AT19V
1000	63	TVX1J102MCA	16 x 31·5	AT20W
2200	35	TVX1V222MCA	16 x 31·5	AT21X
2200	50	TVX1H222MCA	18 x 40	AT22Y
2200	63	TVX1J222MDA	22 x 40	AT23A
4700	35	TVX1V472MDA	22 x 40	AT24B

Order	Type	Price each exc. Vat 7011			inc. Vat
Code		1+	50+	100+	1+
51549	GenElect 1uF 100V	£0.119	£0.090	£0.080	£0.140
51550	GenElect 2.2uF 100V	£0.127	£0.093	£0.082	£0.150
51551	GenElect 10uF 25V	£0.127	£0.093	£0.082	£0.150
51552	GenElect 10uF 63V	£0.144	£0.100	£0.092	£0.170
51553	GenElect 22uF 63V	£0.170	£0.125	£0.106	£0.200
51554	GenElect 47uF 16V	£0.153	£0.112	£0.095	£0.180
51555	GenElect 47uF 63V	£0.246	£0.188	£0.165	£0.290
51556	GenElect 47uF 450V	£1.860	£1.620	£1.450	£2.190
51557	GenElect 100uF 10V	£0.229	£0.190	£0.155	£0.270
51558	GenElect 100uF 35V	£0.246	£0.200	£0.160	£0.290
51559	GenElect 100uF 63V	£0.280	£0.225	£0.180	£0.330
51560	GenElect 220uF 16V	£0.161	£0.120	£0.100	£0.190
51561	GenElect 220uF 35V	£0.280	£0.225	£0.180	£0.330
51562	GenElect 470uF 10V	£0.212	£0.165	£0.138	£0.250
51563	GenElect 470uF 16V	£0.221	£0.170	£0.142	£0.260
51564	GenElect 470uF 25V	£0.314	£0.245	£0.225	£0.370
51565	GenElect 470uF 63V	£0.544	£0.442	£0.376	£0.640
51566	GenElect 1000uF 10V	£0.255	£0.210	£0.178	£0.300
51567	GenElect 1000uF 16V	£0.280	£0.216	£0.182	£0.330
51568	GenElect 1000uF 35V	£0.638	£0.405	£0.355	£0.750
51569	GenElect 1000uF 63V	£0.808	£0.680	£0.590	£0.950
51570	GenElect 2200uF 35V	£0.808	£0.680	£0.590	£0.950
51571	GenElect 2200uF 50V	£1.520	£1.250	£1.050	£1.790
51572	GenElect 2200uF 63V	£1.690	£1.410	£1.200	£1.990
51573	AxlElect 4700uF 35V	£1.690	£1.380	£1.150	£1.990

CONNECTORS

Moulded Chassis Socket Plastic Bezel

Cliff



Standard 6·35mm (1/4in.) moulded jack socket with 2 break contacts. Mounting hole: 11mm dia. Available with solder tags or PCB mounting pins.

Order	Type	Price each exc. Vat 1298			inc. Vat
Code		1+	25+	100+	1+
51574	Jack Skt Brk	£0.417	£0.340	£0.290	£0.490
51575	Mono PCB 1/4in J/Skt	£0.417	£0.340	£0.290	£0.490

Moulded Chassis Socket with Chromed Bezel

Cliff

Standard 6.35mm (1/4in.) moulded stereo jack socket with 3 break contacts. Bezel is domed and chromed and contacts are nickel silver. Mounting hole: 11mm dia.

Order	Type	Price each exc. Vat 982			inc. Vat
Code		1+	25+	100+	1+
51576	Chro Stereo Jack Skt	£0.757	£0.550	£0.460	£0.890

Plastic Plug

A phono plug with a smart screw-on plastic cap. Available in Black, Blue, Red, White and Yellow. Overall length: 34mm. Pin length: 9mm from end of shield. Overall diameter: 11·5mm.

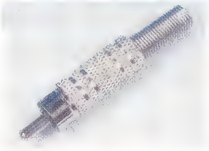
Order	Type	Price each exc. Vat 999			inc. Vat
Code		1+	25+	100+	1+
51577	Screw-Cap Phono Blk	£0.280	£0.220	£0.190	£0.330
51578	Screw Cap Phono Blue	£0.280	£0.220	£0.190	£0.330
51579	Screw Cap Phono Red	£0.280	£0.220	£0.190	£0.330
51580	Screw Cap Phono Whte	£0.280	£0.220	£0.190	£0.330
51581	Screw Cap Phono Yell	£0.280	£0.220	£0.190	£0.330

Plastic Plug with Strain Relief Sleeve

A phono plug having a coloured plastic screw-on body. When the body is unscrewed the threaded moulding on the plug is exposed, which is colour matched to the body. The body is of hexagonal section and includes a strain relief sleeve. Available in red and black.

Order	Type	Price each exc. Vat 1000			inc. Vat
Code		1+	25+	100+	1+
51582	Phono Plug Red	£0.272	£0.195	£0.155	£0.320
51583	Phono Plug Black	£0.272	£0.195	£0.155	£0.320

Screened Plug



A screened phono plug with a metal barrel and coiled spring cable relief sleeve.

Order	Type	Price each exc. Vat 1002			inc. Vat
Code		1+	25+	100+	1+
51584	Phono Plug Screened	£0.417	£0.320	£0.265	£0.490

Single-Hole Fixing Chassis Socket

A chassis mounting phono socket that requires a single hole fixing. Mounting hole: 6·35mm dia.

Order	Type	Price each exc. Vat 1009			inc. Vat
Code		1+	25+	100+	1+
51585	Chassis Phono Skt	£0.365	£0.250	£0.195	£0.430

Chassis Sockets

Chassis mounting phono sockets fixed to paxolin panels.

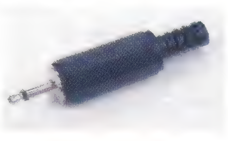
Type	No. of sockets	Dimensions of mount mm	Fixing centres mm	Socket centres mm
Single	1	35 x 22	26	–
Twin	2	56 x 22	48	20
Quad	4	76 x 24	65	14
2 Square	4	49 x 36	40 x 26	15 x 16
6-Way	6	65 x 36	55 x 26	15 x 16
8-Way	8	80 x 36	70 x 26	15 x 16

Fixing holes are 3·75mm dia. Phono sockets require 8·5mm dia. cut-outs.

Order	Type	Price each exc. Vat 1013			inc. Vat
Code		1+	25+	100+	1+
51586	Phono Socket Single	£0.195	£0.155	£0.135	£0.230
51587	Phono Socket Twin	£0.331	£0.250	£0.205	£0.390
51588	Phono Socket Quad	£0.502	£0.400	£0.350	£0.590
51589	Phono Socket 2 Sqre	£0.510	£0.430	£0.370	£0.600
51590	Phono Socket 6-way	£0.672	£0.575	£0.520	£0.790
51591	Phono Socket 8-Way	£0.893	£0.715	£0.650	£1.050

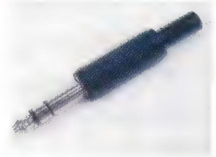
Plastic Barrel Plug with Strain Relief Sleeve

A 2·5mm mono jack plug with plastic barrel and strain relief sleeve.



Order	Type	Price each exc. Vat 1126			inc. Vat
Code		1+	25+	100+	1+
51592	2.5 Plug Plas SR	£0.340	£0.250	£0.210	£0.400

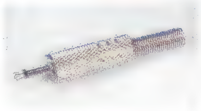
Plastic Barrel Plug



A standard 6.35mm (1/4in.) stereo jack plug with plastic barrel and strain relief sleeve.

Order	Type	Price each exc. Vat 975			inc. Vat
Code		1+	25+	100+	1+
51593	Jack Pl Sto Plas	£0.587	£0.380	£0.285	£0.690

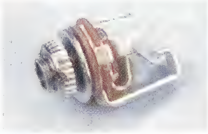
Screened Plug



2·5mm jack plug with metal barrel and coiled spring cable relief sleeve.

Order Code	Type	Price each exc. Vat 1132			inc. Vat
		1+	25+	100+	1+
51594	2.5 Plug Scr	£0.365	£0.290	£0.240	£0.430

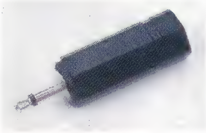
Chassis Socket



2·5mm jack socket, open-type with break contact. Mounting hole: 3·8mm dia.

Order Code	Type	Price each exc. Vat 1133			inc. Vat
		1+	25+	100+	1+
51595	2.5 Jack Socket	£0.323	£0.260	£0.240	£0.380

2·5mm Plug to 3·5mm Socket



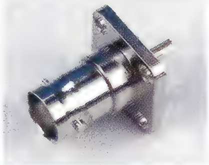
Allows a 3·5mm mono jack plug to be used with a 2·5mm mono jack socket.

Order Code	Type	Price each exc. Vat 1139			inc. Vat
		1+	25+	100+	1+
51596	2.5 - 3.5mm Adptr	£0.536	£0.375	£0.280	£0.630

BNC Chassis Socket

Amphenol RFX

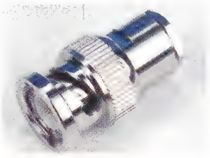
A high quality BNC chassis socket with gold plated contacts.



Order Code	Type	Price each exc. Vat 1526			inc. Vat
		1+	10+	50+	1+
51597	31-0203-RFX	£1.880	£1.430	£1.270	£2.210

BNC Plug Clamp Type

Amphenol RFX

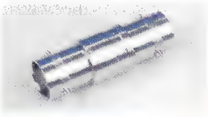


A high quality BNC plug with gold plated contacts and cable clamp fixing. This connector is suitable for use with 75Ω screened cable RG59, Order Code XS52G.

Order Code	Type	Price each exc. Vat 1528			inc. Vat
		1+	10+	50+	1+
51598	31-0212-RFX	£1.800	£1.520	£1.390	£2.120

BNC Socket to BNC Socket Adaptor

Amphenol RFX

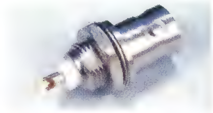


A high quality BNC socket to BNC socket adaptor with gold plated contacts.

Order Code	Type	Price each exc. Vat 1532			inc. Vat
		1+	10+	50+	1+
51599	31-0219-RFX	£3.730	£3.140	£2.760	£4.390

BNC Chassis Socket

Amphenol RFX

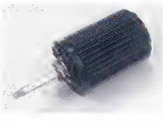


A high quality BNC chassis socket with solder connections and gold plated contacts.

Order Code	Type	Price each exc. Vat 1534			inc. Vat
		1+	10+	50+	1+
51600	31-0221-RFX	£1.300	£1.100	£0.950	£1.530

Miniature 1mm Size

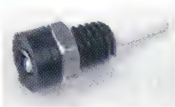
Plug



1mm plug suitable for low voltage circuits. Strong acetal moulding and silver-plated pin. Available in red and black. Overall length: 16mm. Pin length: 6mm. Overall diameter: 6mm.

Order Code	Type	Price each exc. Vat 1423			inc. Vat
		1+	25+	100+	1+
51601	1mm Plug Black	£0.212	£0.175	£0.155	£0.250
51602	1mm Plug Red	£0.212	£0.175	£0.155	£0.250

Socket



1mm socket suitable for low voltage circuits. Strong acetal moulding and silver-plated contact. Available in red and black. Overall length: 16mm. Bezel diameter: 6mm. Mounting hole: 5mm dia.

Order Code	Type	Price each exc. Vat 1425			inc. Vat
		1+	25+	100+	1+
51603	1mm Socket Black	£0.204	£0.155	£0.130	£0.240
51604	1mm Socket Red	£0.204	£0.155	£0.130	£0.240

4mm Size

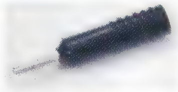
Low Cost Plug

A 4mm plug suitable for use with 4mm sockets below. Sprung plug ensures good contact with socket. Available with red and black handles. Overall length 50mm. Pin length 15mm. Overall diameter 11mm.

Order Code	Type	Price each exc. Vat 1434			inc. Vat
		1+	25+	100+	1+
51605	Banana Plug Red	£0.263	£0.175	£0.150	£0.310
51606	Banana Plug Black	£0.263	£0.175	£0.150	£0.310

2mm Size

Plug



2mm plug with silver- plated pin rated at 10A. Available in black and red. Note that to unscrew body, hold in one hand and turn plastic body clockwise with other hand. Overall length: 32mm. Pin length: 9mm. Overall dia: 6mm.

Order Code	Type	Price each exc. Vat 1427			inc. Vat
		1+	25+	100+	1+
51607	2mm Plug Black	£0.323	£0.240	£0.210	£0.380
51608	2mm Plug Red	£0.323	£0.240	£0.210	£0.380

Socket

2mm socket with silver-plated contact, rated at 10A. Available in Black and Red. Overall length: 19·5mm. Bezel: 6 x 6mm. Mounting hole: 5mm dia.

Order Code	Type	Price each exc. Vat 1429			inc. Vat
		1+	25+	100+	1+
51609	2mm Socket Black	£0.323	£0.240	£0.210	£0.380
51610	2mm Socket Red	£0.323	£0.240	£0.210	£0.380

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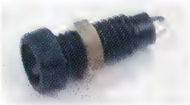
Socket



4mm socket with silver-plated contact. Available in Black, Blue, Green, Red, White and Yellow. Overall length: 29·2mm. Bezel diameter: 11·7mm. Mounting hole: 8mm dia.

Order Code	Type	Price each exc. Vat 1437			inc. Vat
		1+	25+	100+	1+
51611	4mm Socket Black	£0.374	£0.290	£0.275	£0.440
51612	4mm Socket Blue	£0.374	£0.290	£0.275	£0.440
51613	4mm Socket Green	£0.374	£0.290	£0.275	£0.440
51614	4mm Socket Red	£0.374	£0.290	£0.275	£0.440
51615	4mm Socket White	£0.374	£0.290	£0.275	£0.440
51616	4mm Socket Yellow	£0.374	£0.290	£0.275	£0.440

Stackable 4mm Plugs

A range of 4mm banana plugs which have an integral 4mm socket allowing plugs to be stacked one into another. The sprung contact ensures good electrical connection with the socket. Available in black, blue, green, red and yellow.

Order Code	Type	Price each exc. Vat 1442			inc. Vat
		1+	25+	100+	1+
51617	Stack Plg 4mm Black	£0.570	£0.380	£0.330	£0.670
51618	Stack Plg 4mm Blue	£0.570	£0.380	£0.330	£0.670
51619	Stack Plg 4mm Green	£0.570	£0.380	£0.330	£0.670
51620	Stack Plg 4mm Red	£0.570	£0.380	£0.330	£0.670
51621	Stack Plg 4mm Yell	£0.570	£0.380	£0.330	£0.670

3- to 8-Pin Plugs

3-pin plug	HH25C
4-pin plug	HH26D
5-pin plug 180° (Type A)	HH27E
5-pin plug 240° (Type B)	HH28F
5-pin plug 360° domino-style (Type C)	RK64U
6-pin plug	HH29G
7-pin plug	HH30H
8-pin plug with all outer pins in the same arc	FJ91Y
8-pin plug with two pins in a different arc from the other outer pins	FG40T

All types with solder connections.

Order Code	Type	Price each exc. Vat 944			inc. Vat
		1+	25+	100+	1+
51622	DIN Plug 3-pin	£0.331	£0.220	£0.190	£0.390
51623	DIN Plug 4-pin	£0.374	£0.270	£0.230	£0.440
51624	DIN Plug 5-pin A	£0.382	£0.275	£0.235	£0.450
51625	DIN Plug 5-pin B	£0.382	£0.275	£0.235	£0.450
51626	DIN Plug 5-pin C	£0.382	£0.275	£0.235	£0.450
51627	DIN Plug 6-pin	£0.417	£0.285	£0.240	£0.490
51628	DIN Plug 7-pin	£0.502	£0.350	£0.300	£0.590
51629	DIN Plug 8-Pin Circ	£0.527	£0.365	£0.310	£0.620
51630	DIN Plug 8-pin Offst	£0.502	£0.350	£0.300	£0.590

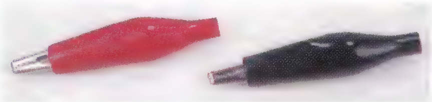
There are plenty more connectors in the new Maplin MPS catalogue.

4mm Patch Cord

50cm (20in.) and 100cm (40in.) long patch cords for setting up test gear etc., comprising an extra flexible wire terminated at each end with a piggy-back 4mm plug and integral socket. Any number of these can be stacked. Each plug pin is 18mm long and has high quality sprung contacts. 50cm types available in three colours, Black, Red and Green. 100cm types available in Red and Black only. Sold singly.

Order Code	Type	Price each exc. Vat 1443			inc. Vat
		1+	25+	100+	1+
51631	4mm Patch Cord Blk	£1.180	£0.950	£0.800	£1.390
51632	4mm Patch Cord Grn	£1.180	£0.950	£0.800	£1.390
51633	4mm Patch Cord Red	£1.180	£0.950	£0.800	£1.390
51634	100cm Patch Cord Blk	£1.400	£1.090	£0.910	£1.650
51635	100cm Patch Cord Red	£1.400	£1.090	£0.910	£1.650

Miniature Crocodile Clips



A range of crocodile clips with insulating vinyl covers in six colours, Red, Black, Yellow, Green, White and Blue. Clips are 27mm long. Overall length with sleeve 33mm. Also available with completely gold-plated clip with Red or Black sleeve.

Order Code	Type	Price each exc. Vat 1057			inc. Vat
		1+	25+	100+	1+
51636	Red Croc Clip	£0.229	£0.160	£0.140	£0.270
51637	Black Croc Clip	£0.229	£0.160	£0.140	£0.270
51638	Yellow Croc Clip	£0.229	£0.160	£0.140	£0.270
51639	Green Croc Clip	£0.229	£0.160	£0.140	£0.270
51640	White Croc Clip	£0.229	£0.160	£0.140	£0.270
51641	Blue Croc Clip	£0.229	£0.160	£0.140	£0.270
51642	Gold Croc Clip Red	£0.272	£0.180	£0.155	£0.320
51643	Gold Croc Clip Black	£0.272	£0.180	£0.155	£0.320

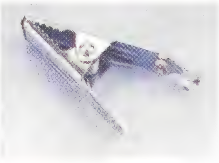
Standard Crocodile Clips

A range of crocodile clips with insulating vinyl covers in six colours, Red, Black, Yellow, Green, White and Blue. Clips are 35mm long. Overall length with sleeve 42mm. Also available with completely gold-plated clip with Red or Black sleeve.

Order Code	Type	Price each exc. Vat 1058			inc. Vat
		1+	25+	100+	1+
51644	Stnd Croc Clip Red	£0.221	£0.145	£0.125	£0.260
51645	Stnd Croc Clip Black	£0.221	£0.145	£0.125	£0.260
51646	Stnd Croc Clip Yellw	£0.221	£0.145	£0.125	£0.260
51647	Stnd Croc Clip Green	£0.221	£0.145	£0.125	£0.260
51648	Stnd Croc Clip White	£0.221	£0.145	£0.125	£0.260
51649	Stnd Croc Clip Blue	£0.221	£0.145	£0.125	£0.260
51650	Gld Std CrocClip Red	£0.297	£0.200	£0.170	£0.350
51651	Gld Std CrocClip Blk	£0.297	£0.200	£0.170	£0.350

Battery Charger Clips

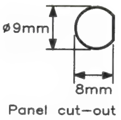
Union Brothers



Large plated clip as used on battery chargers. Overall length 75mm. Width of jaws 15mm, maximum gap between jaws when fully opened 28mm. Current rating 25A.

Order Code	Type	Price each exc. Vat 1060			inc. Vat
		1+	25+	100+	1+
51652	Charger Clip	£0.400	£0.260	£0.225	£0.470

Terminal Post with Small Handle



Nickel-plated brass terminal post rated 15A at 250V. It has a 4mm top socket and 2·1mm dia. hole in post. Knob size: 14mm x 11·5mm dia. Fits panels from 0·9mm to 5mm (20swg to 6swg) thickness. Available in the following colours: Black, Blue, Green, Red, White and Yellow.

Order Code	Type	Price each exc. Vat 1075			inc. Vat
		1+	25+	100+	1+
51653	Small Term Post Blk	£0.587	£0.420	£0.370	£0.690
51654	Small Term Post Blue	£0.553	£0.390	£0.350	£0.650
51655	Small Term Post Grn	£0.553	£0.390	£0.350	£0.650
51656	Small Term Post Red	£0.553	£0.390	£0.350	£0.650
51657	Small Term Post Wht	£0.553	£0.390	£0.350	£0.650
51658	Small Term Post Ylw	£0.553	£0.390	£0.350	£0.650

Spade Terminals Screw Type

Cliff

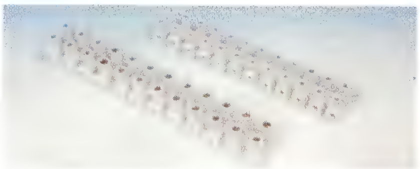
A spade terminal with insulated handle forming a 4mm socket, for use with our terminal posts. Grub screw in handle clamps wire to spade. Spade has 6·3mm (1/4in.) opening. Overall length 42mm. Overall width 15mm.
Available in red and black.

Order Code	Type	Price each exc. Vat 1083			inc. Vat
		1+	25+	100+	1+
51659	Screw Spade Red	£0.502	£0.355	£0.300	£0.590
51660	Screw Spade Black	£0.502	£0.355	£0.300	£0.590

You'll find more connectors and lots more enclosures in our current catalogue.

Nylon Terminal Blocks

Camden



A range of 12 way terminal strips manufactured in self extinguishing nylon 66. Easily cut to size the strips are approved by UL, CSA, IMQ, KEMA, VDE, SEMKO, DEMKO, OVE & SEV.
Max Voltage 380VAC
Max Working Temperature 120°C

Dimensions mm.

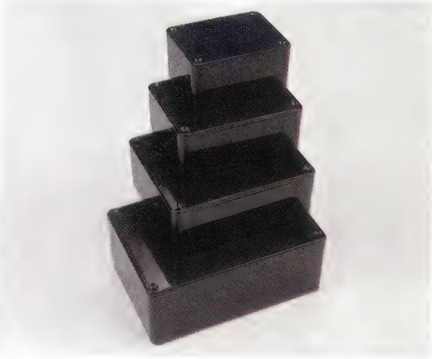
Current Rating	Max Wire size	Width	Length	Height	Pitch
6A	4.0	16.4	94.9	14.5	8
10A	4.0	18.1	116.0	16.0	10
16A	10	23.1	139.8	21.0	12
32A	16	31.6	174.0	24.6	14.5

Order Code	Type	Price each exc. Vat 12133			inc. Vat
		1+	25+	100+	1+
51661	12Way Nylon Term 6A	£0.672	£0.540	£0.480	£0.790
51662	12Way Nylon Term 10A	£0.842	£0.625	£0.560	£0.990
51663	12Way Nylon Term 16A	£1.090	£0.900	£0.810	£1.290
51664	12Way Nylon Term 32A	£2.110	£1.720	£1.550	£2.490

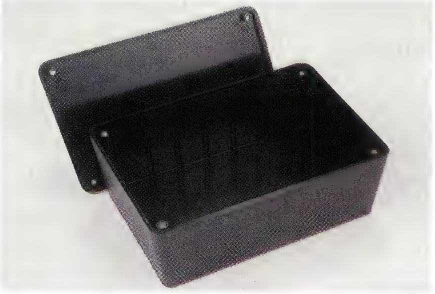
ENCLOSURES

MB Plastic Boxes

A range of glossy and matt finish black plastic boxes moulded in ABS with brass inserts. Lid and screws to fix lid are supplied. Lid is lipped to ensure a good fit. Insides of all except MB6 are grooved on all walls to accept PCBs etc. Types MB4 and MB6 have a matt external finish.



Type	Internal (mm)	External (mm)
MB1	76 x 58 x 36	79 x 62 x 39
MB2	97 x 73 x 39·5	100 x 76 x 41
MB3	115 x 95 x 43·5	118 x 98 x 45
MB4	208 x 122 x 81	216 x 130 x 85
MB5	145 x 95 x 57·5	150 x 100 x 60
MB6	214 x 143 x 61	220 x 150 x 64
MB7	172 x 115 x 79	177 x 120 x 83
MB8	145 x 75 x 46	150 x 80 x 50



Order Code	Type	Price each exc. Vat 1676			inc. Vat
		1+	25+	100+	1+
51665	ABS Box MB1	£1.640	£1.430	£1.250	£1.930
51666	ABS Box MB2	£1.990	£1.710	£1.480	£2.340
51667	ABS Box MB3	£2.160	£1.880	£1.610	£2.540
51668	ABS Box MB4	£6.060	£5.470	£4.730	£7.130
51669	ABS Box MB5	£3.020	£2.600	£2.380	£3.560
51670	ABS Box MB6	£4.590	£4.210	£3.690	£5.400
51671	ABS Box MB7	£3.890	£3.550	£3.150	£4.580
51672	ABS Box MB8	£2.590	£2.320	£2.040	£3.050

FIXINGS & HARDWARE

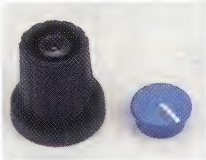
Small Ridged Knobs

Two knobs with white pointer line and a skirt. Sides have narrow raised ridges for a firm grip. Fitted with a spun aluminium insert. KB3 has recess for control fixing nut. KB4: Diameter 20mm. Height 17mm. KB3: Diameter 35mm. Height 22mm.

Order Code	Type	Price each exc. Vat 1803 1+	25+	100+	inc. Vat 1+
51673	Knob KB4	£0.476	£0.396	£0.302	£0.560
51674	Knob KB3	£0.561	£0.468	£0.416	£0.660

Low Cost 'Collet' Knobs

Re-An



An attractive black silk-finish plastic knob in a style similar to true collet knobs, but having grub-screw fixing for standard 6·35mm (1/4in.) shaft. The knob has an integral nut-cover, and seven different colour caps are available separately to plug in the top of the knob body. Has recess for control fixing nut.

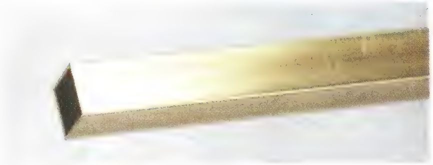
Diameter: 19mm.
Height: 21mm (with cap).

Caps are engraved with white indicator line. (White cap has black line.)

Order Code	Type	Price each exc. Vat 1845 1+	25+	100+	inc. Vat 1+
51675	Low-Cost Collet Knob	£0.425	£0.349	£0.307	£0.500
51676	LC Cap Black	£0.093	£0.084	£0.079	£0.110
51677	LC Cap Blue	£0.093	£0.084	£0.079	£0.110
51678	LC Cap Green	£0.093	£0.084	£0.079	£0.110
51679	LC Cap Grey	£0.093	£0.084	£0.079	£0.110
51680	LC Cap Red	£0.093	£0.084	£0.079	£0.110
51681	LC Cap White	£0.093	£0.084	£0.079	£0.110
51682	LC Cap Yellow	£0.093	£0.084	£0.079	£0.110

Square Brass Tube

K & S



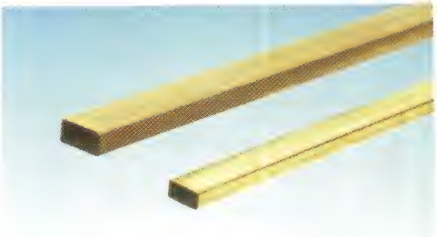
High quality square-section brass tubing, ideal for a range of modelling applications. Supplied in 305mm lengths.

Order Code	Outside Diameter (mm)
HZ43W	1·6
HZ44X	2·4
HZ45Y	3·2
HZ46A	4
HZ47B	4·8
HZ48C	5·6
HZ49D	6·4

Order Code	Type	Price each exc. Vat 11473 1+	inc. Vat 1+
51683	1.6x305mm Br SqTube	£0.859	£1.010
51684	2.4x305mm Br SqTube	£0.944	£1.110
51685	3.2x305mm Br SqTube	£1.020	£1.210
51686	4x305mm Br SqTube	£1.120	£1.320
51687	4.8x305mm Br SqTube	£1.370	£1.620
51688	5.6x305mm Br SqTube	£1.460	£1.720
51689	6.4x305mm Br SqTube	£1.640	£1.930

Rectangular Brass Tube

K & S



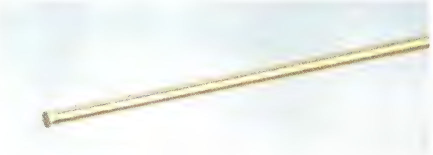
High quality rectangular-section brass tubing, ideal for a range of modelling applications. Supplied in 305mm lengths.

Order Code	Dimensions (mm)
LJ01B	2·4 x 4·8 x 305
LJ02C	3·2 x 6·4 x 305
LJ03D	4 x 7·9 x 305
LJ04E	4·8 x 9·5 x 305

Order Code	Type	Price each exc. Vat 11659 1+	inc. Vat 1+
51690	2.4x4.8x305mm BrTube	£1.640	£1.930
51691	3.2x6.4x305mm BrTube	£1.890	£2.230
51692	4x7.9x305mm BrTube	£2.070	£2.440
51693	4.8x9.5x305mm BrTube	£2.070	£2.440

Brass Rod

K & S



High quality round brass rods, ideal for a range of modelling applications. Supplied in 305mm lengths.

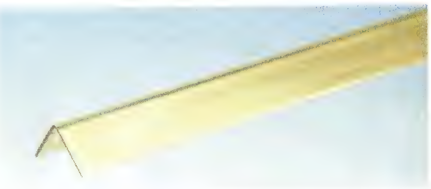
Order Code	Outside Diameter (mm)
HZ50E	0·5
HZ51F	0·8
HZ52G	1·2
HZ53H	1·6
HZ60Q	1·8
HZ59P	2
HZ54J	2·4
HZ58N	2·9
HZ55K	3·2
HZ56L	4
HZ57M	4·8

Order Code	Type	Price each exc. Vat 11468 1+	inc. Vat 1+
51694	0.5x305mm Br Rod	£0.161	£0.190
51695	0.8x305mm Br Rod	£0.161	£0.190
51696	1.2x305mm Br Rod	£0.255	£0.300
51697	1.6x305mm Br Rod	£0.340	£0.400
51704	1.8x305mm Br Rod	£0.340	£0.400
51703	2x305mm Br Rod	£0.510	£0.600
51698	2.4x305mm Br Rod	£0.510	£0.600
51702	2.9x305mm Br Rod	£0.510	£0.600
51699	3.2x305mm Br Rod	£0.689	£0.810
51700	4x305mm Br Rod	£0.944	£1.110
51701	4.8x305mm Br Rod	£1.020	£1.210

See our catalogue for a greater range of fuses and hardware.

Brass Angle

K & S



High quality brass angle, ideal for a range of modelling applications.

Order Code	Dimensions mm
HZ61R	3·2 x 3·2 x 305
HZ62S	4 x 4 x 305
HZ63T	4·8 x 4·8 x 305
HZ64U	5·6 x 5·6 x 305
HZ65V	6·4 x 6·4 x 305

Order Code	Type	Price each exc. Vat 11471 1+	inc. Vat 1+
51705	3.2x3.2x305mm Br Ang	£0.689	£0.810
51706	4x4x305mm Br Ang	£0.774	£0.910
51707	4.8x4.8x305mm Br Ang	£0.689	£0.810
51708	5.6x5.6x305mm Br Ang	£0.774	£0.910
51709	6.4x6.4x305mm Br Ang	£0.774	£0.910

FUSES

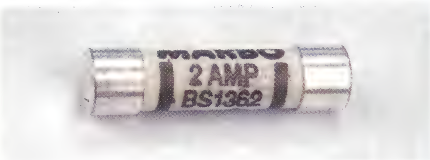
20mm Quickblow Type

Glass tube fuses with nickel-finish brass end caps overall size 20 x 5mm diameter. Fuses rupture within 2 minutes max (1s typical) at 25°C at twice the rated current. Rupture capacity 35A or 20 times the rated current whichever is greater.

Available in the following ratings:
50mA, 63mA, 80mA, 100mA, 125mA, 160mA, 200mA, 250mA, 315mA, 400mA, 500mA, 630mA, 800mA, 1A, 1.25A, 1.6A, 2A, 2.5A, 3.15A, 4A, 5A, 6.3A, 10A.

Order Code	Type	Price each exc. Vat 451 1+	50+	250+	inc. Vat 1+
51710	Fuse 20mm 50mA	£0.170	£0.141	£0.126	£0.200
51711	Fuse 20mm 63mA	£0.119	£0.091	£0.081	£0.140
51712	Fuse 20mm 80mA	£0.119	£0.091	£0.081	£0.140
51713	Fuse 20mm 100mA	£0.068	£0.061	£0.056	£0.080
51714	Fuse 20mm 125mA	£0.068	£0.061	£0.056	£0.080
51715	Fuse 20mm 160mA	£0.068	£0.061	£0.056	£0.080
51716	Fuse 20mm 200mA	£0.068	£0.061	£0.056	£0.080
51717	Fuse 20mm 250mA	£0.068	£0.061	£0.056	£0.080
51718	Fuse 20mm 315mA	£0.068	£0.061	£0.056	£0.080
51719	Fuse 20mm 400mA	£0.068	£0.061	£0.056	£0.080
51720	Fuse 20mm 500mA	£0.068	£0.061	£0.056	£0.080
51721	Fuse 20mm 630mA	£0.068	£0.061	£0.056	£0.080
51722	Fuse 20mm 800mA	£0.068	£0.061	£0.056	£0.080
51723	Fuse 20mm 1A	£0.068	£0.061	£0.056	£0.080
51724	Fuse 20mm 1.25A	£0.068	£0.061	£0.056	£0.080
51725	Fuse 20mm 1.6A	£0.068	£0.061	£0.056	£0.080
51726	Fuse 20mm 2A	£0.068	£0.061	£0.056	£0.080
51727	Fuse 20mm 2.5A	£0.068	£0.061	£0.056	£0.080
51728	Fuse 20mm 3.15A	£0.068	£0.061	£0.056	£0.080
51729	Fuse 20mm 4A	£0.068	£0.061	£0.056	£0.080
51730	Fuse 20mm 5A	£0.068	£0.061	£0.056	£0.080
51731	Fuse 20mm 6.3A	£0.068	£0.061	£0.056	£0.080
51732	Fuse 20mm 10A	£0.068	£0.061	£0.056	£0.080

25·4mm (1in.) Type Domestic Mains Fuses



Standard electrical plug fuses to BS1362. Size 25·4 x 6·4mm (1 x $^{1}/_{4}$in.)

Available in the following ratings. 2A, 3A, 5A, 7A, 10A, 13A.
Available singly and in packs of 10.

Order Code	Type	Price each exc. Vat 4526 1+	10+	25+	inc. Vat 1+
51733	Plug Fuse 2A	£0.161			£0.190
51734	Plug Fuse 3A	£0.161			£0.190
51735	Plug Fuse 5A	£0.161			£0.190
51736	Plug Fuse 7A	£0.161			£0.190
51737	Plug Fuse 10A	£0.161			£0.190
51738	Plug Fuse 13A	£0.161			£0.190
51739	Plug Fuse 2A 10 Pk	£1.190	£0.970	£0.899	£1.400
51740	Plug Fuse 3A 10 Pk	£1.190	£0.970	£0.899	£1.400
51741	Plug Fuse 5A 10 Pk	£1.190	£0.970	£0.899	£1.400
51742	Plug Fuse 7A 10 Pk	£1.190	£0.970	£0.899	£1.400
51743	Plug Fuse 10A 10 Pk	£1.190	£0.970	£0.899	£1.400
51744	Plug Fuse 13A 10 Pk	£1.190	£0.970	£0.899	£1.400

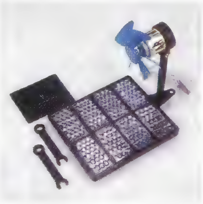
OPTOELECTRONICS

Solar Cell Educational Kits

Basic Kit

An educational kit to help you explore solar energy power. The kit includes a solar panel (0·45V 400mA), a small DC motor, connecting wire, plastic fan spinner and turntables, coloured spinner disks, coloured paper models, screws and nuts. An interesting kit for children to enjoy. A very informative booklet is included describing solar power in detail.

Advanced Kit



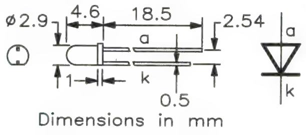
A more advanced kit that includes eight solar panels that produce 0·4V at 100mA each, and can be configured to produce 0·4V at 800mA or 3·2V at 100mA by connecting the cells in parallel or series, or a combination of both. It is possible to power small appliances, i.e. radios, personal cassettes, calculators, from sunlight. A detailed booklet is included in the kit that explains how to connect up the cells. A small electric fan along with connecting straps and wire are included in the kit to demonstrate the use of solar power.

Order Code	Type	Price each exc. Vat 2310 1+	10+	25+	inc. Vat 1+
51745	Basic Solar Kit	£5.090	£3.950	£3.500	£5.990
51746	Advanced Solar Kit	£9.350	£7.250	£5.950	£10.990

3mm Diameter Types

Kingbright

A good quality, bright, miniature LED available in six colours. Case size: 3mm dia. A panel mounting clip is available, sold separately. Cathode denoted by flat on body and by short lead.



	Red	Green	Orange	Yellow	Pure Green	Pure Orange
Light output typical at I_F = 20mA:	3mcd	12mcd	20mcd	20mcd	20mcd	40mcd
Forward voltage at I_F = 20mA:	2V	2.2V	2V	2.1V	2V	2.2V
Forward current (max):	20mA	30mA	30mA	30mA	50mA	50mA
Reverse voltage (max)	5V	5V	5V	5V	5V	5V
Power dissipation (max):	120mW	105mW	105mW	105mW	105mW	105mW
Peak wavelength:	665nm	565nm	625nm	595nm	555nm	610nm

The LED has a diffused lens which gives a wide viewing angle of 120°.

Also available in pure green (555nm) and pure orange (610nm).

Order Code	Type	Price each exc. Vat 2045 1+	25+	100+	inc. Vat 1+
51747	Mini LED Red	£0.093	£0.075	£0.063	£0.110
51748	Mini LED Green	£0.102	£0.078	£0.070	£0.120
51749	Mini LED Orange	£0.144	£0.110	£0.095	£0.170
51750	Mini LED Yellow	£0.127	£0.095	£0.085	£0.150
51751	Mini LED Pure Green	£0.161	£0.120	£0.100	£0.190
51752	Mini LED Pure Orange	£0.161	£0.120	£0.100	£0.190

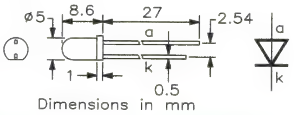
5mm Diameter Types

Kingbright

A good quality, bright standard LED available in six colours. Case size: 5mm dia. Panel mounting clips are sold separately. Cathode denoted by flat on body and by short lead.

	Red	Green	Orange	Yellow	Pure Green	Pure Orange
Light output typical at I_F = 20mA	8mcd	8mcd	30mcd	30mcd	20mcd	40mcd
Forward voltage at I_F = 20mA	2V	2·2V	2V	2·1V	2V	2·2V
Forward current (max)	20mA	30mA	30mA	30mA	50mA	50mA
Reverse voltage (max)	5V	5V	5V	5V	5V	5V
Power dissipation (max)	120mW	105mW	105mW	105mW	105mW	105mW
Peak wavelength	665nm	565nm	625nm	595nm	555nm	610nm

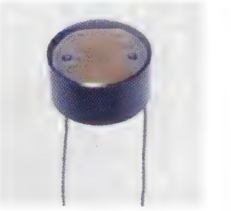
The LED has a diffused lens which gives a wide viewing angle of 120°.

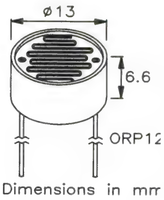


Order Code	Type	Price each exc. Vat 2047 1+	25+	100+	inc. Vat 1+
51753	LED Red	£0.085	£0.070	£0.060	£0.100
51754	LED Green	£0.102	£0.080	£0.070	£0.120
51755	LED Orange	£0.127	£0.100	£0.085	£0.150
51756	LED Yellow	£0.127	£0.100	£0.085	£0.150
51757	LED Pure Green	£0.161	£0.120	£0.100	£0.190
51758	LED Pure Orange	£0.161	£0.120	£0.100	£0.190

Photoconductive Cell

Silonex





A cadmium sulphide photoconductive cell sensitive to visible light. It has a maximum sensitivity in the green, yellow, orange and red parts of the spectrum (wavelengths: 480-690nm). Resistances quoted are those measured when the cell is illuminated by a lamp of colour temperature 2854°K. For other light sources the cell resistance should be multiplied by the following approximate factors.

Source of illumination	Multiplication Factor
Incandescent radiation at colour temperature of: 1500°K	x0·5
2000°K (oil-fired burner-yellow flame)	x0·66
Sunlight	x1·33
White fluorescent light	x2

Where cell is operated from a 50Hz AC source the resistance values are between 1 and 1·3 times those for DC.

Type	Incidence of illumination	Cell resistance	Min. dark resistance at 50 lux
ORP12	End-on	6000Ω	1MΩ
Type	**Min bright resistance**	**Max. power dissipation**	**Max. cell voltage**
ORP12	80Ω*	250mW	320V

* At 10,000 lux.

Order Code	Type	Price each exc. Vat 2248 1+	25+	100+	inc. Vat 1+
51759	LDR ORP12	£1.090	£0.870	£0.690	£1.290

Laser Pointer Kit

A simple and cost effective kit that forms a handy Class IIIA laser pointer for teachers, lecturers and demonstrators. The kit comprises a moulded plastic box, press button, laser diode, battery connections and two 'AAA' type cells. Simple assembly is involved, the most difficult part being the soldering of the battery contacts. Includes full operating instructions. Also available is a line generating lens (WC98G) for providing a single line of intense light as opposed to a single spot.

CAUTION: Do not stare directly or indirectly into the laser output aperture or retinal damage may occur.

Order Code	Type	Price each exc. Vat 9336 1+	inc. Vat 1+
51760	Laser Pointer Kit	£30.370	£35.690
51761	Line Generating Lens	£1.290	£1.520

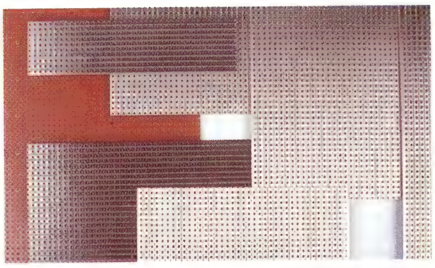
PANEL METERS

Educational Ammeters and Voltmeters

These benchtop instruments offer exceptional value with their compact size and rugged construction. They provide a range of DC measurement of ±21/2% accuracy (±4% on 0-2A) with uniform scales and high levels of electrical and mechanical stability in the highly visible transparent covers.
Dimensions 80 x 120 x 52mm
Weight 200gm approx.

Order Code	Type	Price each exc. Vat 12130 1+	10+	25+	inc. Vat 1+
51762	Bench Meter 0-1A	£6.800	£5.450	£4.750	£7.990
51763	Bench Meter 0-2A	£6.800	£5.450	£4.750	£7.990
51764	Bench Meter 0-5A	£6.800	£5.450	£4.750	£7.990
51765	Bench Meter 0-6V	£6.800	£5.450	£4.750	£7.990
51766	Bench Meter 0-15V	£6.800	£5.450	£4.750	£7.990

SRBP Matrix Boards



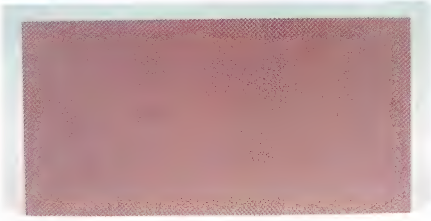
A range of SRBP boards punched with holes on a 2·54mm (0·1in.) matrix. Plain board and boards with copper strips on one side are available in various sizes.

Type	Overall size (mm)	Number of copper strips	Number of holes in each strip
Plain 3962	160 x 100	none	39 x 62
Plain 3929	100 x 75	none	39 x 29
Plain 39117	300 x 100	none	39 x 117
Strip 1039	100 x 25	10	39
Strip 2939	100 x 74·1	29	39
Strip 2958	150 x 74·1	29	58
Strip 3939	100 x 100	39	39
Strip 3962	160 x 100	39	62
Strip 39117	300 x 100	39	117

All boards have 1mm dia. holes and are 1·6mm thick.

Order Code	Type	Price each exc. Vat 1917 1+	25+	100+	inc. Vat 1+
51767	Plain Board 3962	£1.270	£0.980	£0.859	£1.500
51768	Plain Board 3929	£0.851	£0.657	£0.545	£1.000
51769	Plain Board 39117	£2.130	£1.770	£1.520	£2.510
51770	Strip Board 1039	£0.510	£0.404	£0.354	£0.600
51771	Strip Board 2939	£1.370	£1.110	£0.960	£1.610
51772	Strip Board 2958	£1.710	£1.410	£1.230	£2.010
51773	Strip Board 3939	£1.540	£1.210	£0.960	£1.810
51774	Strip Board 3962	£2.130	£1.570	£1.310	£2.510
51775	Strip Board 39117	£3.850	£2.880	£2.420	£4.530

Copper-Clad Boards



A range of copper-clad boards suitable for making your own printed-circuit boards.
The following types and sizes are available:
Single-sided SRBP:
203 x 102mm (8 x 4in.) (Small single)
254 x 152mm (10 x 6in.) (Medium single)
305 x 203mm (12 x 8in.) (Large single)
Double-sided SRBP:
203 x 102mm (8 x 4in.) (Small double)
254 x 152mm (10 x 6in.) (Medium double)
305 x 203mm (12 x 8in.) (Large double)
Single-sided Fibreglass:
203 x 102mm (8 x 4in.) (Small single)
254 x 152mm (10 x 6in.) (Medium single)
305 x 203mm (12 x 8in.) (Large single)
Double-sided Fibreglass:
203 x 102mm (8 x 4in.) (Small double)
254 x 152mm (10 x 6in.) (Medium double)
305 x 203mm (12 x 8in.) (Large double)

Order Code	Type	Price each exc. Vat 2112 1+	25+	100+	inc. Vat 1+
51776	PCB SRBP Smll Single	£0.851	£0.677	£0.505	£1.000
51777	PCB SRBP Med Single	£1.190	£0.919	£0.778	£1.400
51778	PCB SRBP Lrg Single	£2.050	£1.620	£1.320	£2.410
51779	PCB SRBP Small Doubl	£0.936	£0.758	£0.576	£1.100
51780	PCB SRBP Med Doubl	£1.540	£1.160	£1.010	£1.810
51781	PCB SRBP Lrg Doubl	£2.570	£1.970	£1.740	£3.020
51782	PCB F.Glass Sm Sngl	£1.540	£1.160	£1.010	£1.810
51783	PCB F.Glass Med Sngl	£2.130	£1.670	£1.360	£2.510
51784	PCB F.Glass Lrg Sngl	£3.250	£2.580	£2.320	£3.830
51785	PCB F.Glass Smll Dbl	£1.370	£1.010	£0.879	£1.610
51786	PCB F.Glass Med Dble	£2.130	£1.670	£1.360	£2.510
51787	PCB F.Glass Lrg Dbl	£3.420	£2.630	£2.420	£4.030

PCB & CIRCUIT DEVELOPMENT

Euro Breadboard

This plugblock has a total of 600 contacts arranged in four blocks of 25 rows of five interconnected sockets on a 2·54 x 2·54mm matrix and four other rows of 25 interconnected sockets arranged around the edges of the main matrix for use as bus-bars. The distance between the two centre rows of sockets is 15·2mm, the spacing between the leads on a 24, 28 or 40-pin IC and the distance between the centre rows of sockets of both end blocks of contacts is 7·62mm, the spacing between leads on an 8, 14 or 16-pin IC package. Thus the block will hold up to six 14-pin and two 24-pin DIL packages for example. A non-slip rubber backing is fixed to the board and fixing is by four holes in the corners of the block into which will screw a No.4 self-tapper. The holes are 8BA clear. Horizontal rows are designated 1 to 25 whilst the four matrixed blocks are labelled A, B, C and D and the four bus-bar rows are labelled X1, X2, Y1 and Y2.

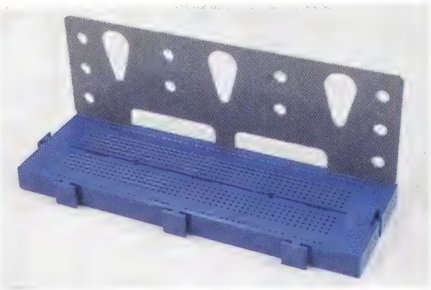
Specification:

Contacts:	Nickel silver
Contact resistance:	<10mΩ
Contact rating:	1A
Contact life:	>5000 insertions
Accepts wire dia:	0·25 to 0·85mm
Dimensions:	92 x 82 x 10mm
Fixing holes:	78·5 x 68mm

Order Code	Type	Price each exc. Vat 1963 1+	10+	25+	inc. Vat 1+
51788	Eurobreadboard	£10.300	£8.180	£7.520	£12.110

ORDER BEFORE 5PM FOR SAME DAY DESPATCH
Tel: 01702 554000
Fax: 01702 554001
e-mail: Sales@maplin.co.uk

Professional Plugblock



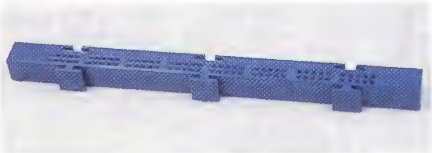
This plugblock has a total of 550 contacts arranged in two blocks of 47 rows of five interconnected sockets on a 2·54 x 2·54mm matrix and two other rows of forty interconnected sockets on either side of the length of the main matrix for use as bus-bars. The distance between the two centre rows of sockets is 7·62mm, the spacing between the leads on an 8, 14 or 16-pin DIL package. Thus the block will hold up to six 14-pin or nine 8-pin DIL packages for example. The rear plastic panel unclips to allow the contact arrangements to be seen and any contact strip to be changed should it ever be damaged. Boards may be clipped together horizontally or vertically to make larger arrays for more complex circuits. All contact positions are clearly identified on an alpha-numeric grid. A component support bracket is supplied with the block. It will fit onto any outside edge or down the centre with cut-outs in the bottom of the bracket allowing it to sit over ICs. The bracket has ten 5mm dia. holes and three tapered holes from 4mm to 12·7mm dia. punched into it, enabling mounting of potentiometers, rotary and toggle switches, lamp-holders, push-button switches and other components normally mounted on panels.

Specification:

Body material:	Thermoplastic polyester
Temperature range:	–50 to +125°C
Contact resistance:	<10mΩ
Contact rating:	1A
Contact to contact capacity:	0·5pF
Contacts:	Nickel silver
Contact life:	>5000 insertions
Accepts wires dia:	0·25 to 0·85mm
Dimensions:	150 x 50 x 10mm

Order Code	Type	Price each exc. Vat 1969 1+	10+	25+	inc. Vat 1+
51789	Prof Plugblock	£12.020	£9.340	£8.530	£14.130

Bus-Strip Plugblock



For use with our Professional Plugblock this block clips on to any side to provide additional bus-bars. The block has a total of 80 contacts arranged in two strips of forty interconnected sockets.
The rear plastic panel unclips to allow the contact arrangement to be seen and any contact strip to be changed should it ever be damaged.
Other details as Professional Plugblock.

Order Code	Type	Price each exc. Vat 1973 1+	10+	25+	inc. Vat 1+
51790	Bus-Strip Plugblock	£3.940	£3.510	£3.350	£4.640

Access VISA AMERICAN EXPRESS SWITCH
Maplin MPS accepts all of these
Tel: 01702 554000
Fax: 01702 554001

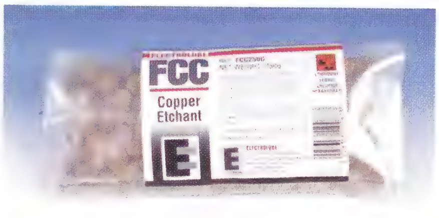
Printed Circuit Board Etch Resist Marker Pen

A nylon tipped pen for fast fabrication of perfect printed circuit boards. The ink adheres perfectly to copper and is completely resistant to ferric chloride and other usual etchant solutions. Draw the planned circuit onto a thoroughly cleaned copper laminated board and allow to dry. Then immerse the board in etching fluid until the copper is dissolved. The ink can then be removed with Degreasing Solvent or PCB Cleaner, and the circuit board is then ready to be drilled and assembled. This pen is capable of producing thin, delicate lines allowing for quite a condensed track layout if required. It can also be used as an indelible marker felt tip pen for an enormous range of materials especially metals.

Order Code	Type	Price each exc. Vat 2104			inc. Vat
		1+	25+	100+	1+
51806	PCB Pen	£1.540	£1.160	£1.010	£1.810

Ferric Chloride Crystals

Electrolube



A pack of Ferric Chloride (FeCl3) crystals for etching copper clad boards. Packet contains sufficient crystals to make one pint of solution. Dissolve in 250ml of warm water. Store and etch in plastic or glass vessels. With regular stirring, etching will take about 20 minutes or longer depending on how many times solution has been used before. One pint will etch about 2260sq.cm. (350sq.in.).

Order Code	Type	Price each exc. Vat 2097			inc. Vat
		1+	10+	50+	1+
51807	Etch Crystals	£4.710	£3.790	£3.480	£5.540

For more circuit development aids see the new Maplin MPS catalogue.

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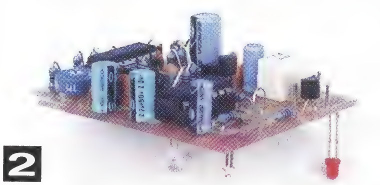
means fast service and best value for money

KITS & MODULES

Infra-Red Switch



2

Features
- ★ *Low cost*
- ★ *High sensitivity*
- ★ *High immunity to spurious triggering*
- ★ *Changeover relay output*
- ★ *Flexible power supply requirement*

Applications
- ★ *Alarm systems*
- ★ *Production lines*
- ★ *Home automation*

Have you ever wondered how the hot-air hand driers in public conveniences work? You place your wet hands under the drier and it starts up – withdraw them and it stops. It's magic – or is it? In fact, what you are experiencing is yet another application of infra-red energy. Radiation from an infra-red source (generally an LED) is reflected off your wet hands and is picked up by a sensor, which subsequently operates the drier. Infra-red switches are often found in hot-air hand driers but they can equally be used for operating light switches (with the aid of LP55K opto-switch), or solenoid water valves in scrub rooms, turning on a shower when you step into it, an automatic doorbell, part of a production run counter on assembly lines, or even a reverse-parking radar. The number of applications is endless. The Maplin infra-red switch has three possible modes of operation – toggle, momentary, and only when infra-red energy is being detected. The basic operation of an infra-red proximity switch is quite simple. The energy produced by an infra-red source is reflected, by the object to be detected, to a sensor. The output from the sensor is amplified, filtered and used to drive an external circuit. Many natural and everyday objects emit infra-red radiation, and if the detector circuit was a 'straight' one, spurious triggering from these sources would result. However, this problem is overcome by relying on a 5kHz stream of infra-red pulses (thankfully rare in nature!), rather than the continuous presence of radiation. The 5kHz pulse train is generated by a LM567 tone decoder (a form of phase-locked loop, PLL for short), and is used to drive the infra-red LED. The 5kHz infra-red pulse train, when reflected by an incident object, is received by an infra-red photodiode, and is then amplified and filtered. The processed pulse train is then fed back into the tone decoder, which senses that they are of the same frequency as those it is generating, and flags an output to that effect. This output is used, with additional circuitry, to switch a relay.

Specification

Quiescent current:	12mA
Operating current:	46mA
Supply voltage:	12V DC, 9V AC or 9V-0-9V AC
PCB size:	65mm x 50mm

Optional Items

The following items, not included in the kit, may also be required.

ABS Box type MB1	1	(LH20W)
35mm Flush Metal Wall Box	1	(ZB75S)
40mm Surface Pattress	1	(ZB40T)
Blanking Plate	1	(HL86T)
M3 x 10mm Insulated Spacer	2	(FS36P)
Miniature Screened Cable	As Req.	(XR15R)
2·4mm Heat Shrink Sleeving	As Req.	(BF87U)
6·4mm Heat Shrink Sleeving	As Req.	(BF90X)
Epoxy Resin Sachet	1	(FL45Y)
9V 250mA Transformer	1	(YN15R)
20mm Fuseholder	1	(KU33L)
20mm Fuseholder	1	(RX96E)
Fuseholder Insulating Boot	1	(FT35Q)
T50mA Fuse	1	(UJ90X)
Unregulated 300mA AC/DC PSU	1	(XX09K)
2·5mm Panel Power Socket	1	(JK10L)

Kit and Special Parts

A complete kit of parts (including the PCB) is available (excluding optional items). The PCB is also available separately. Full construction details can be found in Maplin Magazine Issue 71.

Order Code	Type	Price each exc. Vat 6779	inc. Vat
		1+	1+
51808	I/R Proximity Switch	£13.010	£15.290
51809	I/R Prox Switch PCB	£2.850	£3.360

Watch As You Build Video with Radio Receiver Kit

1

A beginner's starter project which includes a step-by-step construction guide on a VHS video tape. The whole kit is supplied neatly packed into a standard VHS video cassette, together with an accompanying leaflet. By following the instructions on video you will be introduced to the basic techniques of project building, and by the end of the video a simple AM radio receiver circuit will have been constructed, ready to use. Some troubleshooting advice is given at the end. It is recommended that the absolute beginner also purchases a starter tool kit to ensure that they have the correct tools at the outset. Additional kits of parts are also available without the video tape, so that several students can work from one video tape. However, these extra kits cannot be used unless you have at least one video tape.

Order Code	Type	Price each exc. Vat 2686	inc. Vat
		1+	1+
51810	Start Radio & Video	£17.350	£20.390
51811	Start Radio No Video	£9.540	£11.210

Hobbyists Starter Tool Kit

An easily affordable tool kit for the new electronics hobbyist, packaged to suit the typical needs of the beginner and offering considerable savings over buying the items separately. Presented in a cloth toolroll, the pack contains: side cutters; pair of long-nosed pliers with wire cutter; light-duty flat blade screwdriver 75mm long; No. 1 crosspoint screwdriver 75mm long; desoldering tool; and an Antex soldering kit with a CS iron, stand and 5m pack of 18swg multicore solder. Start as you mean to go on, with the right tools.

Order Code	Type	Price each exc. Vat 3843			inc. Vat
		1+	5+	10+	1+
51812 1	Starter Tool Kit	£25.160	£21.800	£20.710	£29.570

Funtronics

A set of projects ideal for the absolute beginner, requiring no soldering and the minimum of tools to construct. A small screwdriver, pliers and wire cutters are normally all that is needed. The components and connecting wire are held in place by self-tapping screws which fit into holes in the plastic 'peg-board' supplied. A component guide-sheet is supplied with each kit and this is cut-out and stuck to the plastic board. The kits include all the parts necessary except the battery and tools.

Optional Items

The following items, not included in the kits, may also be required.

PP3 Battery	As Req.	(JY60Q)
PP3 Alkaline	As Req.	(FK67X)

Snip Cutter	1	(JH20W)
Pliers	1	(FV55K)
Screwdriver	1	(JG98G)

There are 10 projects in the range:

1. Bulb & Fuse Tester

This is a very simple project indeed, it is intended to allow testing of bulbs, fuses, switches etc. If the device under test is good, then an LED lights up.

See Maplin Magazine Issue 48.

2. Transistor Tester

As well as showing you how a transistor works, this handy kit allows you to test diodes or any small or medium NPN or PNP power transistors you may use in your own projects.

See Maplin Magazine Issue 49.

3. Water Indicator

This little project is ideal for detecting water in the soil of house plants and will give a visible indication, an LED will light, when the soil is dry.

See Maplin Magazine Issue 50.

4. Light-Dark Indicator

This project simply switches on an LED if it detects the absence of light. With a simple change to the circuit, this project will do the opposite, i.e. it will operate the LED indicator if the light level is above a certain amount. A useful purpose for a project of this type is a photographic darkroom indicator.

See Maplin Magazine Issue 51.

5. The Flasher

This is an astable circuit that switches on and off two LEDs alternately. The LEDs flash every two or three seconds. Such a project will be of great use to model makers, for example. In its present form, the Flasher is ideal for flashing warning lights on a model level crossing.

See Maplin Magazine Issue 52.

6. Electronic Siren

This little unit is ideal for use with model cars and similar applications. It provides a sound that varies in pitch; you can control this pitch, enabling a useful range of siren sounds to be produced.

See Maplin Magazine Issue 53.

7. Pet Communicator

This project uses an astable multivibrator loaded by a small loudspeaker. At low-light levels the frequency is very low, but in daylight the frequency is very high and will probably not be heard by most humans – but will be heard by your pets. A simple modification will allow this project to operate as an alarm.

See Maplin Magazine Issue 54.

8. Decision Maker

Simple multivibrator circuit that is started by holding two prods together. Two LEDs will flash very fast so that they appear to be on all the time. When the prods are disconnected, a simple 'memory' action holds on one of the LEDs which can be labelled 'yes/no', 'in/out', 'heads/tails' or whatever.

See Maplin Magazine Issue 55.

9. Morse Code Communicator

An astable multivibrator circuit that operates at several hundred pulses per second and produces an audio tone and lights an LED when the 'key' is pressed. This project will help you to learn Morse Code and communicate with others using this special 'language', the circuit is not any form of radio transmitter.

See Maplin Magazine Issue 56..

10. Music Maker

A simple electronic organ that plays 10 notes, enough to play a range of simple tunes. The unit is 'monophonic'; this means it can only play one note at a time. It uses a stylus type 'keyboard'; in other words, you hold a stylus (prod) and play notes by touching it on to the 'keys', which are actually just screw terminals. The circuit is an astable multivibrator that can oscillate at several different frequencies, so as to provide a reasonable range of notes.

See Maplin Magazine issue 57.

Order Code	Type	Price each exc. Vat 2692 1+	inc. Vat 1+
51813	Continuity Tester	£3.460	£4.070
51814	Transistor Tester	£3.460	£4.070
51815	Water Level Indicatr	£3.460	£4.070
51816	L/D Indicator	£4.330	£5.090
51817	Flasher	£3.460	£4.070
51818	Electronic Siren	£4.330	£5.090
51819	Pet Communicator	£5.200	£6.110
51820	Decision Maker	£3.460	£4.070
51821	Morse Communicator	£5.200	£6.110
51822	Music Maker	£4.330	£5.090

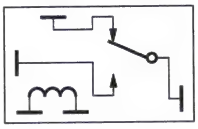
RELAYS

Ultra Miniature High Power Mains Relay

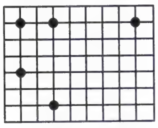
An ultra-miniature relay capable of switching 10A resistive at 240V AC. The relay is fully enclosed and is designed for direct printed circuit mounting. Available with a single-pole changeover silver cadmium oxide contact. Dimensions: 22 x 17·4 x 11·6mm high excluding pins. Pin length: 3mm.

Contact Details:

View from below



View from above



0.1inch matrix

Max current: 10A DC, 10A AC resistive
3A AC inductive
Max voltage: 30V DC, 240V AC
Life at 120V AC: >150,000 operations
Life at 240V AC: >75,000 operations
Max contact resistance: 50mΩ
Operate time: 6ms
Release time: 2ms

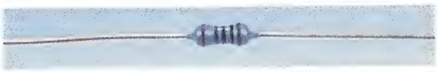
Coil Details:

Nominal voltage: 12V DC
Coil resistance: 320Ω
Operate voltage range: 9V to 19·2V
Must release voltage: >1·2V

Order Code	Type	Price each exc. Vat 2516 1+	25+	100+	inc. Vat 1+
51823	10A Mains Relay	£1.270	£0.948	£0.766	£1.500

RESISTORS

Metal Film 0.6W



A 'Universal Resistor' with a superb specification. It may be used as a superior replacement wherever carbon film 1/4W, 1/3W or 1/2W are specified since its size is the same as 1/4W types, yet it can be run continuously at 0.6W with ambient temperatures up to 70°C, thanks to the highly even thermal characteristics of the ceramic substrate. It is also a superior replacement to most metal oxide and thick film resistors due to its very tight tolerance, ±1%, and its low temperature coefficient, only 50ppm.

Working voltage max: 250V
Tolerance: ±1%
Power rating: 0·6W at 70°C
Temperature coefficient: 50ppm/°C
Noise level: Typically 0.01μV/V
Dimensions of body: 6·5mm long,
2·5mm diameter

Note that to make up 'odd' values not stocked, resistor networks may be built and if all the resistors in the network have a 1% tolerance, then the tolerance of the whole network will still be 1% tolerance.

The following values (Ω) only are available:

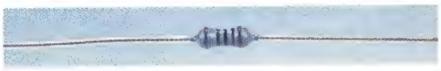
1Ω	10Ω	100Ω	1k0	10k	100k	1M
	11Ω	110Ω	1k1	11k	110k	
1.2Ω	12Ω	120Ω	1k2	12k	120k	1M2
	13Ω	130Ω	1k3	13k	130k	
1.5Ω	15Ω	150Ω	1k5	15k	150k	1M5
	16Ω	160Ω	1k6	16k	160k	
1.8Ω	18Ω	180Ω	1k8	18k	180k	1M8
	20Ω	200Ω	2k0	20k	200k	
2.2Ω	22Ω	220Ω	2k2	22k	220k	2M2
	24Ω	240Ω	2k4	24k	240k	
2.7Ω	27Ω	270Ω	2k7	27k	270k	2M7
	30Ω	300Ω	3k0	30k	300k	
3.3Ω	33Ω	330Ω	3k3	33k	330k	3M3
	36Ω	360Ω	3k6	36k	360k	
3.9Ω	39Ω	390Ω	3k9	39k	390k	3M9
	43Ω	430Ω	4k3	43k	430k	
4.7Ω	47Ω	470Ω	4k7	47k	470k	4M7
	51Ω	510Ω	5k1	51k	510k	
5.6Ω	56Ω	560Ω	5k6	56k	560k	5M6
	62Ω	620Ω	6k2	62k	620k	
6.8Ω	68Ω	680Ω	6k8	68k	680k	6M8
	75Ω	750Ω	7k5	75k	750k	
8.2Ω	82Ω	820Ω	8k2	82k	820k	8M2
	91Ω	910Ω	9k1	91k	910k	
						10M

To order write 'M' and then the value.

E.g. M1R2, M15R, M180R, M2K2, M27K, M330K, M3M9, etc.

Order Code	Type	Price each exc. VAT 1+	10+	100+	2162 1+
M+Value	M1R-M8R2	£0.042	£0.036	£0.030	£0.050
M+Value	M10R-M1M	£0.034	£0.027	£0.021	£0.040
M+Value	M1M2-M2M7	£0.042	£0.036	£0.030	£0.050
M+Value	M3M3-M6M8	£0.119	£0.100	£0.080	£0.140
M+Value	M8M2-M10M	£0.187	£0.170	£0.125	£0.220

Low Cost Metal Film 0·25W Packs of 10/100 Resistors



High stability, low noise. This range of resistors is ideal for use in manufacturing of electronic products where ±5% tolerance is sufficient. Available in packs of 10 or 100 of any 1 value, at a very low price.

Specification:

Working Voltage (max.): 250V
Tolerance: ±5%
Power Rating: 0·25W @ 70°C
Temperature Coefficient: ±200ppm/°C
Dimensions of body: 6·8mm long x 2·5mm dia.

The following values (Ω) only are available:

1Ω	10Ω	100Ω	1k0	10k	100k	1M
	11Ω	110Ω	1k1	11k	110k	
1·2Ω	12Ω	120Ω	1k2	12k	120k	
	13Ω	130Ω	1k3	13k	130k	
1·5Ω	15Ω	150Ω	1k5	15k	150k	
	16Ω	160Ω	1k6	16k	160k	
1·8Ω	18Ω	180Ω	1k8	18k	180k	

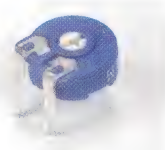
	20Ω	200Ω	2k0	20k	200k
2·2Ω	22Ω	220Ω	2k2	22k	220k
	24Ω	240Ω	2k4	24k	240k
2·7Ω	27Ω	270Ω	2k7	27k	270k
	30Ω	300Ω	3k0	30k	300k
3·3Ω	33Ω	330Ω	3k3	33k	330k
	36Ω	360Ω	3k6	36k	360k
3·9Ω	39Ω	390Ω	3k9	39k	390k
	43Ω	430Ω	4k3	43k	430k
4·7Ω	47Ω	470Ω	4k7	47k	470k
	51Ω	510Ω	5k1	51k	510k
5·6Ω	56Ω	560Ω	5k6	56k	560k
	62Ω	620Ω	6k2	62k	620k
6·8Ω	68Ω	680Ω	6k8	68k	680k
	75Ω	750Ω	7k5	75k	750k
8·2Ω	82Ω	820Ω	8k2	82k	820k
	91Ω	910Ω	9k1	91k	910k

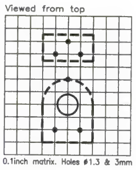
To order write 'F' and then the value for a pack of 10, or 'E' and then the value for a pack of 100.
E.g. E1R2, E12R, E1K2, E12K, E120K, E1M, etc.

Order Code	Type	Price each exc. VAT 6400			
		1+	10+	25+	1+
F+Value	All Values	£0.212			£0.25 0
E+Value	All Values	£1.690	£0.850	£0.720	£1.99.0

Sub-Miniature Fully Enclosed Carbon Presets

Meggitt Piher





A new range of sub-miniature horizontal and vertical mounting linear track presets fully enclosed in a flame retardant plastic housing. The insulated slider can be adjusted from either side by tool with blade 1 to 2·3mm wide. Power rating 0·15W at 40°C. Tolerance ±20% (±30% 2·2MΩ and 4·7MΩ). Enclosure is dust and splash proof. Dimensions 10 x 10·3 x 4·5mm. Vertical type fits flush to PCB (12·1mm overall height from PCB), horizontal type sits 1·5mm proud of PCB (6mm overall height from PCB). Pins require 1·3mm dia. PCB holes. Pin length 4·5mm.

The following values are available in horizontal types:
100Ω, 220Ω, 470Ω, 1k, 2k2, 4k7, 10k, 22k, 47k, 100k, 220k, 470k, 1M, 2M2, 4M7.

Order Code	Type	Price each exc. Vat 6499			inc. Vat
		1+	25+	100+	1+
51824	Hor Encl Preset 100R	£0.170	£0.140	£0.120	£0.200
51825	Hor Encl Preset 220R	£0.170	£0.140	£0.120	£0.200
51826	Hor Encl Preset 470R	£0.170	£0.140	£0.120	£0.200
51827	Hor Encl Preset 1k	£0.170	£0.140	£0.120	£0.200
51828	Hor Encl Preset 2k2	£0.170	£0.140	£0.120	£0.200
51829	Hor Encl Preset 4k7	£0.170	£0.140	£0.120	£0.200
51830	Hor Encl Preset 10k	£0.170	£0.140	£0.120	£0.200
51831	Hor Encl Preset 22k	£0.170	£0.140	£0.120	£0.200
51832	Hor Encl Preset 47k	£0.170	£0.140	£0.120	£0.200
51833	Hor Encl Preset 100k	£0.170	£0.140	£0.120	£0.200
51834	Hor Encl Preset 220k	£0.170	£0.140	£0.120	£0.200
51835	Hor Encl Preset 470k	£0.170	£0.140	£0.120	£0.200
51836	Hor Encl Preset 1M	£0.170	£0.140	£0.120	£0.200
51837	Hor Encl Preset 2M2	£0.170	£0.140	£0.120	£0.200
51838	Hor Encl Preset 4M7	£0.170	£0.140	£0.120	£0.200

The following values are available in vertical types:
470Ω, 1k, 2k2, 4k7, 10k, 22k, 47k, 100k, 220k, 470k, and 1M.

Order Code	Type	Price each exc. Vat 6499			inc. Vat
		1+	25+	100+	1+
51839	Vrt Encl Preset 470R	£0.170	£0.140	£0.120	£0.200
51840	Vrt Encl Preset 1k	£0.170	£0.140	£0.120	£0.200
51841	Vrt Encl Preset 2k2	£0.170	£0.140	£0.120	£0.200
51842	Vrt Encl Preset 4k7	£0.170	£0.140	£0.120	£0.200
51843	Vrt Encl Preset 10k	£0.170	£0.140	£0.120	£0.200
51844	Vrt Encl Preset 22k	£0.170	£0.140	£0.120	£0.200
51845	Vrt Encl Preset 47k	£0.170	£0.140	£0.120	£0.200
51846	Vrt Encl Preset 100k	£0.170	£0.140	£0.120	£0.200
51847	Vrt Encl Preset 220k	£0.170	£0.140	£0.120	£0.200
51848	Vrt Encl Preset 470k	£0.170	£0.140	£0.120	£0.200
51849	Vrt Encl Preset 1M	£0.170	£0.140	£0.120	£0.200

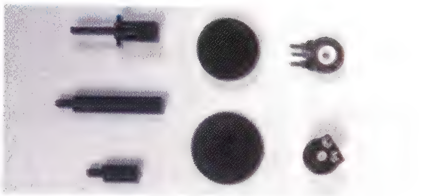
Starter Pack E12

A development pack of Min Resistors containing ten of each of the following values: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68 and 82Ω, plus all the decades up to 1MΩ. 610 resistors in all.

Order Code	Type	Price each exc. Vat 2163			inc. Vat
		1+	5+	10+	1+
51850	E12 Resistor Pack	£12.750	£8.900	£6.500	£14.990

Control Potentiometer Modular System

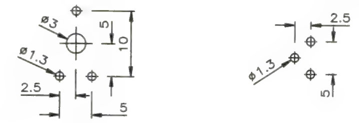
Meggitt Piher



A range of horizontal or vertical 10mm carbon control potentiometers featuring plug-in accessories for additional flexibility. Top, bottom or side actuation with edgewheel operation and stereo (dual) units can be assembled. The carbon on polyester technology ensures stability and durability with a life of 10,000 track operations.

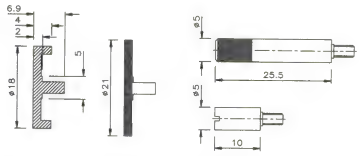
Specification

Resistive element:	Carbon on polyester
Power rating;	0.15W at 40⁰C
Maximum voltage:	200V DC
Resistance tolerance:	±20%
Contact resistance variation:	5% or 3Ω whichever is greater
Nominal rotation	
electrical:	220⁰
mechanical:	235⁰
Rotational life:	10,000 operations
Operating temperature:	-25⁰C to +70⁰C
Dimensions (w x d x h)	
vertical type:	10.3 x 10 x 4.5mm
horizontal type:	10.3 x 4.5 x 12.1mm
Vertical Top adjust	Hoizontal Side Adjust



Available in the following values

vertical: 1k, 2.2k, 4.7k, 10k, 47k, 1M

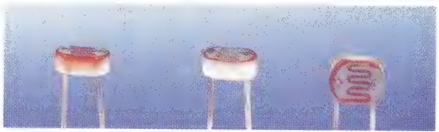


horizontal: 1k, 2.2k, 4.7k, 10k, 22k, 100k

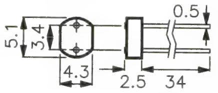
Accessories available	**Order Code**
long shaft	DT47B
short shaft	DT48C
dual gang	DT49D
18mm edgewheel	DT50E

Order Code	Type	Price each exc. Vat 11986			inc. Vat
		1+	25+	100+	1+
51851	Modular Preset V 1k	£0.221	£0.170	£0.150	£0.260
51852	Modular Preset V 2k2	£0.221	£0.170	£0.150	£0.260
51853	Modular Preset V 4k7	£0.221	£0.170	£0.150	£0.260
51854	Modular Preset V 10k	£0.221	£0.170	£0.150	£0.260
51855	Modular Preset V 47K	£0.221	£0.170	£0.150	£0.260
51856	Modular Preset V 1M	£0.221	£0.170	£0.150	£0.260
51857	Modular Preset H 1k	£0.221	£0.170	£0.150	£0.260
51858	Modular Preset H 2k2	£0.221	£0.170	£0.150	£0.260
51859	Modular Preset H 4k7	£0.221	£0.170	£0.150	£0.260
51860	Modular Preset H 10k	£0.221	£0.170	£0.150	£0.260
51861	Modular Preset H 22k	£0.221	£0.170	£0.150	£0.260
51862	Modular Preset H100k	£0.221	£0.170	£0.150	£0.260
51863	Long Shaft	£0.102	£0.075	£0.066	£0.120
51864	Short Shaft	£0.102	£0.075	£0.066	£0.120
51865	Dual Gang Shaft	£0.161	£0.130	£0.120	£0.190
51866	18mm Edgewheel	£0.221	£0.215	£0.205	£0.260

Miniature Light Dependent Resistors



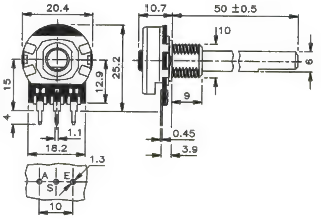
A range of miniature cadmium sulphide (CdS), light dependent resistors. The cells have a maximum voltage rating of 100V DC and a maximum power dissipation of 50mW



Order Code	Max. Resistance at 10lux	Min. Resistance at darkness (0lux)
AZ81C	11kΩ	0.5MΩ
AZ82D	33kΩ	2MΩ
AZ83E	120kΩ	5MΩ

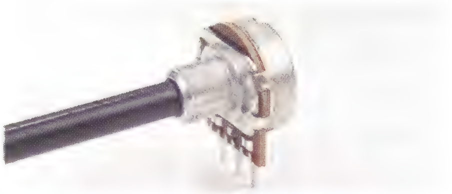
Order Code	Type	Price each exc. Vat 12016			inc. Vat
		1+	25+	100+	1+
51868	LDR 11K	£0.851	£0.540	£0.435	£1.000
51869	LDR33K	£0.851	£0.540	£0.435	£1.000
51870	LDR120K	£0.851	£0.540	£0.435	£1.000

Standard Type



A range of carbon track potentiometers with printed circuit board mounting terminals. Fixing hole required: 10·5mm (13/32in.). Power rating: 0·4W linear, 0·2W log. Max. volt: 500V DC. Tolerance: ±20%. Overall shaft length 50mm.

The following values are available with a linear track:
1k, 4k7, 10k, 22k, 47k, 100k, 220k, 470k, 1M, 2M2



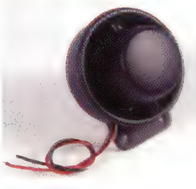
Order Code	Type	Price each exc. Vat 2205			inc. Vat
		1+	25+	100+	1+
51871	Pot Lin 1k	£0.672	£0.550	£0.460	£0.790
51872	Pot Lin 4k7	£0.672	£0.550	£0.460	£0.790
51873	Pot Lin 10k	£0.672	£0.550	£0.460	£0.790
51874	Pot Lin 22k	£0.672	£0.550	£0.460	£0.790
51875	Pot Lin 47k	£0.672	£0.550	£0.460	£0.790
51876	Pot Lin 100k	£0.672	£0.550	£0.460	£0.790
51877	Pot Lin 220k	£0.672	£0.550	£0.460	£0.790
51878	Pot Lin 470k	£0.672	£0.550	£0.460	£0.790
51879	Pot Lin 1M	£0.672	£0.550	£0.460	£0.790
51880	Pot Lin 2M2	£0.672	£0.550	£0.460	£0.790

The following values are available with a logarithmic track:
4k7, 10k, 22k, 47k, 100k, 220k, 470k, 1M, 2M2

Order Code	Type	Price each exc. Vat 2205			inc. Vat
		1+	25+	100+	1+
51881	Pot Log 4k7	£0.731	£0.590	£0.500	£0.860
51882	Pot Log 10k	£0.731	£0.590	£0.500	£0.860
51883	Pot Log 22k	£0.731	£0.590	£0.500	£0.860
51884	Pot Log 47k	£0.731	£0.590	£0.500	£0.860
51885	Pot Log 100k	£0.731	£0.590	£0.500	£0.860
51886	Pot Log 220k	£0.731	£0.590	£0.500	£0.860
51887	Pot Log 470k	£0.731	£0.590	£0.500	£0.860
51888	Pot Log 1M	£0.731	£0.590	£0.500	£0.860
51889	Pot Log 2M2	£0.731	£0.590	£0.500	£0.860

WARNING DEVICES

Small Siren



A small, compact yet powerful siren requiring a power supply of between 6-14v DC making it ideal for a variety of applications.A small mounting bracket is located at the bottom with two fixing holes.

Specification

Power supply range	6-14v DC
Current rating	100mA (at 12v)
Output	108 dB (at 12v)
Diameter	48mm

Order Code	Type	Price each exc. Vat 12571 1+	25+	100+	inc. Vat 1+
51890	Small Siren	£3.390	£2.680	£2.350	£3.990

MULTIMETERS

Pocket Multimeter

Precision Gold

A rugged, easy to operate, general purpose multimeter having a sensitivity of 2000Ω/V for DC and AC voltage ranges. Its compact size and ease of portability makes it ideal for those situations where fast, accurate measurements are required. Ideal for use in the house, boat, car etc.

Ranges:

DC volts:	10, 50, 250, 500V at 2000 ohms per volt
AC volts:	10, 50, 250, 500V at 2000 ohms per volt
DC current:	0.5, 50, 250mA
Resistance:	0 to 1MΩ (5kΩ at centre of scale) (Minimum reading: 200Ω)
Decibels:	-20 to +56dB, using AC volts ranges

The meter has an accuracy of 4% at full scale deflection for DC and AC voltage ranges, and resistance measurements are accurate to 4° of scale arc. The two-colour mirrored scale has a total arc of 90°. Supplied complete with operating instructions, one red and one black test lead with probes and one battery (replacement type AA size). Dimensions 90 x 60 x 30mm. Weight: 110g.

Order Code	Type	Price each exc. Vat 4362 1+	5+	10+	inc. Vat 1+
51891	Pocket Multimeter	£7.800	£6.380	£5.970	£9.170
51892	Case CB2K	£1.690	£1.450	£1.300	£1.990

There are many more test meters in our latest catalogue.

PG010 Digital Multimeter with Test Signal Output and LED Test

- ★ *3½-digit LCD*
- ★ *Test signal output*
- ★ *LED and diode test*
- ★ *Transistor h_{FE}*

For the price, this multimeter offers an amazing range of functions. As well as the usual volts and resistance ranges there are LED and diode test functions, transistor hFE measurement, and a very useful square wave signal output for fault finding. Ideal for the hobbyist and experimenter. A spare set of test leads, (GW92A) are available separately.

Specification

Display: 3½-Digit LCD

DC voltage

Range	Resolution	Accuracy
2V	1mV	±(1·5% rdg + 1dgt)
20V	10mV	±(1·5% rdg + 1dgt)
200V	100mV	±(1·5% rdg + 1dgt)
600V	1V	±(1·5% rdg + 1dgt)

Input impedance:	1MΩ
Overload protection:	600V DC or 500V AC

AC Voltage

Range	Resolution	Accuracy
200V	100mV	±(2·9% rdg+4dgts)
500V	1V	±(2·9% rdg+4dgts)

Input impedance: 450kΩ

Range	Resolution	Accuracy
200Ω	100mΩ	±(1·5% rdg+3dgts)
2kΩ	1Ω	±(1·5% rdg + 1dgt)
20kΩ	10Ω	±(1·5% rdg + 1dgt)
200kΩ	100Ω	±(1·5% rdg + 1dgt)
2MΩ	1kΩ	±(1·5% rdg + 1dgt)

Resistance

Signal output

Voltage:	+3.0V -0.5V
Type:	square wave
Duty cycle:	50%
Frequency:	50Hz approx.
Output impedance:	120kΩ
Input protection:	500V DC or AC rms

LED test

Accuracy:	±(3% rdg + 3dgts)
Resolution:	10mV
Test current:	10mA ±6mA
Test voltage:	<3.5V

Diode test

Accuracy:	±(3% rdg + 3dgts)
Test current:	1.0mA ±0.6mA
Open circuit voltage:	3.3V DC typical
Overload protection:	500V DC or AC rms

Transistor h_{FE}

Ranges:	0 – 1000
Base current:	10μA DC approx.
V_{CE}:	3.0V DC
Dimensions:	151 x 70 x 38mm
Weight:	200g including battery

Order Code		Type	Price each exc. Vat 4401 1+	5+	10+	inc. Vat 1+
51893		Model PG010 Digi M/M	£19.950	£16.270	£14.230	£23.450
51894	1	GW17 Std Calib	£49.940			£58.690
51895	1	GW17 NAMAS Calib	£69.940			£82.190
51896		Test Leads	£2.590	£2.240	£2.020	£3.050

SOLDERING EQUIPMENT

Beginners Soldering Iron

A robust mains-powered 25W general-purpose soldering iron. The handle is yellow and ribbed for extra grip, and a removable clip is supplied to enable the iron to be safely hung up whilst not being used. If the iron is remaining idle while still hot then the iron MUST be placed in a stand, or hung by its clip, for safety reasons. The bit has a 5mm chisel tip and is held in place by one of the grub screws on the barrel. A replacement bit is available separately. The element cannot be changed.

Order Code	Type	Price each exc. Vat 4046 1+	10+	25+	inc. Vat 1+
51897	Econ Solder Iron	£5.200	£3.390	£2.970	£6.110
51898	Econ Bit	£0.859	£0.708	£0.593	£1.010

12W Miniature Soldering Iron Type M

Antex

A 12W miniature 240V AC soldering iron which has a heating element contained in a stainless steel shaft, such that the heat is transferred to the bit with maximum efficiency. The soldering bit (No. 10 fitted) can be easily removed from the shaft for replacement. Ideal for SMD rework and other applications where not too much heat is required. Fitted with 1.8m of mains cable.

Specification

Power consumption:	12W
Breakdown voltage:	1250V
Leakage current:	<5μA
Max. bit temperature:	370°C
Length:	147mm
Weight:	21g

Order Code	Type	Price each exc. Vat 4048 1+	10+	25+	inc. Vat 1+
51899	Iron M	£9.350	£8.250	£7.950	£10.990

Standard Solder

Adepto

A 60% tin, 40% lead alloy solder containing a non- corrosive flux. We recommend this solder for use with the iron-clad and nickel-clad bits supplied with our soldering irons and for use with all the electronic components shown in this catalogue. Melting temperature 188°C. Suggested bit temperature 248°C. Solder is available in 18swg (1.22mm) and 22swg (0.71mm). 18swg is sold in packs of 5m and on 1/2kg reels (approx 61m). 22swg is sold in packs of 10m and on 1/2kg reels (approx 178m).

Order Code	Type	Price each exc. Vat 3940 1+	10+	25+	inc. Vat 1+
51900	5 Mtr Pk 18swg Soldr	£0.944	£0.541	£0.396	£1.110
51901	Solder 22swg 10m pk	£0.944	£0.541	£0.396	£1.110

Order Code		Type	Price each exc. Vat 3940 1+	10+	20+	inc. Vat 1+
51902	1	18 swg Solder Reel	£7.800	£4.950	£4.210	£9.170
51903	1	22 swg Solder Reel	£8.670	£5.670	£4.680	£10.190

Semiconductors

Discrete Components

Type	NPN Bipolar Transistors	Case Style	Order Code	Price ex. VAT 1+	25+	inc. VAT 1+
BC108C	Low power general purpose transistor - 300mW	TO18	51904	£0.246	£0.200	£0.29
BC548	Low power general purpose transistor - 500mW	TO92a	51905	£0.102	£0.055	£0.12
BFY51	Low power driver transistor - 1A	TO5	51906	£0.391	£0.315	£0.46
BC337	Low power driver transistor - 625mW	TO92h	51907	£0.136	£0.105	£0.16
2N2222A	Low power RF signal transistor - 360mW	TO18	51908	£0.263	£0.245	£0.31
BD135	Medium power output transistor - 8W, complementary to BD136	TO126	51909	£0.442	£0.325	£0.52
TIP3055	High power output transistor - 90W, complementary to TIP2955	P3c	51910	£1.010	£0.950	£1.19
TIP122	High power darlington transistor - 65W	P1b	51911	£0.842	£0.600	£0.99

Type	PNP Bipolar Transistors					
BC558	Low power general purpose - 500mW	TO92a	51912	£0.102	£0.055	£0.12
BC327	Low power driver transistor - 625mW	TO92h	51913	£0.136	£0.105	£0.16
BD136	Medium power output transistor - 8W, complementary to BD135	TO126	51914	£0.417	£0.315	£0.49
TIP2955	High power output transistor - 90W, complementary to TIP3055	P3c	51915	£1.180	£1.050	£1.39

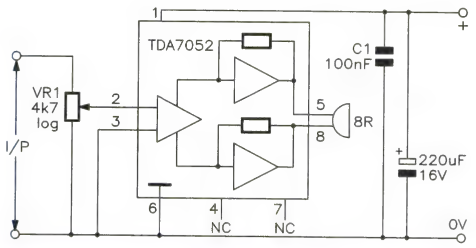
Type	Thyristor					
C106D	General purpose 5A Thyristor (SCR) - 400V PIV	P1a	51916	£0.646	£0.460	£0.76

Type	Diodes	Case Style	Order Code	Price ex. VAT 1+	100+	inc. VAT 1+
1N4148	Silicon signal diode - up to 75mA, 100V PIV	DO35	51917	£0.068	£0.026	£0.08
1N4001	Silicon rectifier diode - up to 1A, 50V PIV	DO41	51918	£0.059	£0.035	£0.07
OA90	Germanium RF detector diode - 10mA, 30V PIV	DO7	51919	£0.238	£0.150	£0.28

Integrated Circuits

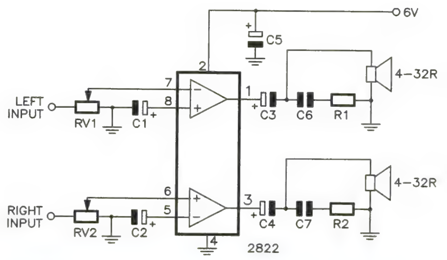
Type	Analogue Devices	Case Style	Order Code	Price ex. VAT 1+	25+	inc. VAT 1+
NE555	Accurate timer/delay circuits or a stable oscillator	8-pin DIL	51920	£0.502	£0.320	£0.59
LM741	Industry standard operational amplifier (op-amp) equivalent to µA741	8-pin DIL	51921	£0.442	£0.300	£0.52
LF351	FET input op-amp ideal for audio, sample-and- hold and D/A converters	8-pin DIL	51922	£0.502	£0.390	£0.59
TBA820M	1 Watt mono audio amplifier suitable for battery operation (3V to 16V supply)	8-pin DIL	51923	£0.502	£0.440	£0.59
TDA7052	1 Watt mono audio amplifier that requires very few extra components	8-pin DIL	51924	£1.690	£1.250	£1.99
TDA2822	1 Watt stereo audio amplifier	8-pin DIL	51925	£1.090	£0.780	£1.29
TDA1020	10 Watt mono audio amplifier for working from car batteries or suitable PSU	9-pin SIL	51926	£2.110	£1.510	£2.49

Application Circuits



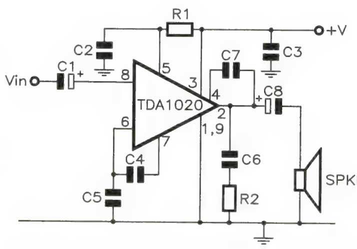
TDA7052 amplifier circuit requiring very few external components - output is 1.2W into 8Ω load from 6V supply.

Part		Order Code
VR1	4k7 Log	FW21X
C1	100nF	DT98G
C2	220µF	FF13P



TDA2822M stereo power amp that can drive headphones, from 3V supply.

Part	Order Code	Part	Order Code
R1,2	M4R7	C3,4	FF15R
RV1,2	FW24B	C5	FF04E
C1,2	JL19V	C6,7	BX76H



TDA1020 amplifier circuit that will drive a 2Ω load (4Ω speakers in parallel) - up to 12W output.

Part	Order Code				
R1,3	M20K	R6	M3R3	C4	AU04E
R2	M680R	R7	M470K	C5,8	BX80B
R4	M82R	C1	FF01B	C6	JL22Y
R5	M150R	C2	WX60Q	C7	WW19V
		C3	FF09K		

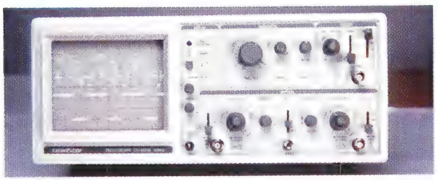
Type	Regulators	Case Style	Order Code	Price ex. VAT 1+	25+	inc. VAT 1+
7805	5 Volt regulator @ 1A, DC input voltage range +7V to +25V	P1d	51927	£0.331	£0.240	£0.39
KA317T	+1.2V to +37V @ 1.5A max. variable regulator - input range +3V to +40V (equivalent to LM317T)	P1e	51928	£0.680	£0.570	£0.80

Type	Digital Devices					
74LS08	Four AND gates (2-inputs per gate)	14-pin DIL	51929	£0.306	£0.230	£0.36
74LS32	Four OR gates (2-inputs per gate)	14-pin DIL	51930	£0.306	£0.230	£0.36
74LS14	Six NOT gates (1-input per gate) - also known as inverting buffers	14-pin DIL	51931	£0.391	£0.300	£0.46
74LS00	Four NAND gates (2-inputs per gate)	14-pin DIL	51932	£0.306	£0.230	£0.36
74LS93	4-bit binary counter	14-pin DIL	51933	£1.350	£1.050	£1.59
74LS47	7-segment LED display driver	16-pin DIL	51934	£1.010	£0.740	£1.19

TEST & MEASURING EQUIPMENT

20MHz 2-Channel Oscilloscope OS-9020P

Goldstar



A portable 2-channel, dual trace oscilloscope built to a high quality. The 9020P has all the capabilities required of a general purpose oscilloscope and will accept signals from DC to 20MHz and includes TV field and line triggering for video work.

Features

Large 150mm (6in.) high luminance CRT with internal graticule of 8 x 10cm. Wide dynamic range even at high frequencies where sensitivity is down -3dB. Fast rise time with low overshoot. Flat frequency response up to half of the -3dB frequency point. Selectable alternate and chop for 2-channel display. Polarity inversion and algebraic summing of channel 1 and channel 2. Superb, jitterless trigger sensitivity. TV sync separator and hold-off useful for video signal observation. Z-axis brightness modulation available.

Specification

Bandwidth:	DC to 2MHz (–3dB)
Coupling:	DC
Input impedance:	20kΩ to 30kΩ
Vertical deflection (Ch1 & Ch2):	
Bandwidth:	DC (–3dB @ 10Hz) to 20MHz (7MHz if x5 X magnification on)
Modes:	Ch1, Ch2, Add, Dual, Chop, Alt.
Sensitivity:	5mV/cm to 5V/cm in 10 calibrated steps in 1-2-5 sequence ±3% (1mV/cm to 1V/cm if x5 magnification on, ±5%)
Accuracy:	±3% (±5% if x5 magnification on)
Input impedance:	1MΩ/25pF
Maximum input voltage:	250V DC + peak AC
Input coupling:	DC/AC/Gnd ref.
Risetime:	<17·5ns (<50ns if x5 magnification on)
Horizontal deflection:	
Sweep modes:	A, X-Y
Timebase A:	0·2μs/cm to 0·2s/cm in 19 calibrated steps in 1-2-5 sequence
Sweep magnification:	10 times (20ns/cm max.)
Accuracy:	±3% (add 2% for magnifier)
Triggering:	
Modes:	Auto, Norm, TV vertical, TV horizontal
Source:	Ch1, Ch2, Line, External
Coupling:	AC
Sensitivity, Auto, Norm:	0·5cm @ 20Hz to 2MHz internal, 0·2V pk-pk external 1·5cm @ 2MHz to 20MHz internal, 0·8V pk-pk external
TV field or line:	At least 1cm internal or 1V pk-pk external
External trigger input impedance:	1MΩ/30pF
Maximum input voltage:	250V DC + peak AC
X-Y operation:	
Sensitivity:	Same as vertical deflection for both Ch1 = X and Ch2 = Y
X-axis bandwidth:	DC to 500kHz (–3dB)
Calibrator:	1kHz square wave, 0·5V pk-pk ±3%, 50% duty cycle
Power supply:	
Line voltage:	240V AC ±10%
Power consumption:	30W

Supplied with operating manual, mains lead, spare fuse. Case fitted with stand. A service manual (AP95D) is available separately. Probes not included.

Order Code		Type	Price each exc. Vat 5897			inc. Vat
			1+	5+	10+	1+
51935	20	Scope OS-9020A	£286.450	£280.500	£270.300	£336.59
51936	19	GW03 Std Calib	£336.450			£395.33
51937	19	GW03 NAMAS Calib	£361.440			£424.70
51938		Manual fr GW03/04/06	£14.990 NV			£14.990

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(Oxford Road)	0161 236 0281	0161 237 1977
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Milton Keynes	01908 692 720	01908 692 725
Northampton	01604 756 726	01604 752 437
Nottingham	0115 941 0242	0115 941 0247
Norwich	OPENING SOON	

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Beat the festive bore with our Christmas projects galore!

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This fine example of arboreal high technology is decorated with 21 LEDs in three seasonal colours, which can be made to flash or twinkle at three different rates. The kit also contains a full-size template to help you make your tree.

PROJECT RATING ③ £15.29

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Project details in *Electronics* No. 48 (XA48C).

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PROJECT RATING ② £27.53

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Project details in *Electronics* No. 78 (XA78K).

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Give the fairy a rest this year and yule have the smartest tree in the street! Lift your tree's decorations onto a heavenly plane with our 19-LED, four colour, twinkling Christmas Star. The kit includes all items needed, except the star itself which you can use your own creative flair to design.

PROJECT RATING ① £10.19

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Project details in *Electronics* No. 41 (XA41U).

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This simple to build, electronic candle has a realistic pseudo-random flicker, but won't burn a hole in your pocket – or anything else for that matter. Ideal for decorations, nativity plays and carol singing. The kit includes constructional details of a suitable cardboard lantern for the festive season.

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Project details in *Electronics* No. 72 (XA72P).

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No more arguments over who answered first! The fastest finger on the button lights up that contestant's lamp and locks out all the others. Ideal for Christmas games, and quiz nights, etc. Up to eight contestants can be catered for, and the unit can be expanded to 16 or 24 by adding a second or third PCB.

PROJECT RATING ① £13.25

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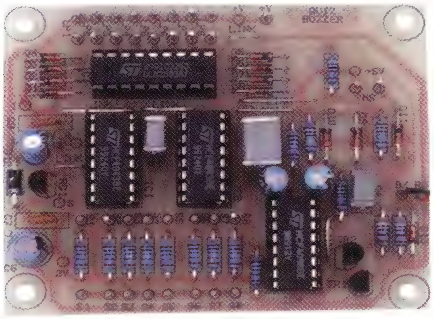
Project details in *Electronics* No. 72 (XA72P).



Finish off the pud, pick up your soldering iron and make a Merry Christmas with festive projects from MAPLIN

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You can please some of the people some of the time . . .

Dear Sir,

I have just finished reading your latest excellent (as always) article, on the Netscape Navigator 3.0 Browser, in my airmailed subscription copy of the September 1996 issue of *Electronics*. I've been using the 32-bit Navigator 3.0b5 for the past couple of months now and although I have not yet tried out CoolTalk, must thoroughly agree with everything else you have to say about this browser. So far, I haven't come across any discernable bugs. Fortunately, having the benefit of Netscape's CD, I didn't have to download it from their homepage. I must say, however, that I run Windows '95 on a 486DX-4 100MHz platform with 20M-byte of RAM, a 1G-byte hard drive, quad-speed CD-ROM, Pro Audio Spectrum 16 and a 28·8k-bps v34 modem, and can't imagine how anyone has the patience to get along with anything less!

dougalp@ang.sequel.net,
Angeles City, The Philippines.

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. . . But you can't please all the people all of the time!

Dear Editor,

I was sorry to hear that Stephen Waddington thinks he's getting a "...reduction in the cost of software..." (*Electronics* September 1996 page 73, 'Navigator 3.0 Browser').

Add up the cost of one person's time plus 'phone bills in trying to download software, retrying persistently until an error-free copy is finally (hopefully!) obtained. Now think of the time and cost of running of an individual copy of the manual on your own printer, as distinct from the unit cost of a mass-produced version. This is NOT reduction in cost. It is the passing of a commercial organisation's costs onto the paying customer. Their profits are boosted at our expense, and Stephen Waddington has fallen for this ploy without a second thought! We hear so much about 'lean, efficient, competitive British business'. Although it sounds good, it's a myth when you start to delve more deeply. I object to the now common practice of businesses increasing their profits by making me do their work for them. If we all think about it, and apply sufficient pressure where it matters, we can stop this recent trend in its tracks.

Dr. G. L. Manning, Edgware,
Middlesex.

There are many computer users/enthusiasts who are willing to spend the time downloading software from sources such as the Internet, perhaps for the reason that it represents something of a challenge, rather than simply buying a ready-packaged version – even though it may not necessarily be cost-effective in the long run. This is analogous to constructing your own electronic projects; it may be more cost-effective and sensible to purchase a ready-made product, but it's usually far more entertaining and rewarding to build your own. Additionally, with some software, a user manual is superfluous, so by downloading just the software, you would save on paying for a manual which you might not even bother reading. You would also be kinder to the environment, by avoiding the use of materials and energy that goes into making the manuals and packaging, and in transporting the end product! Sometimes, less is more.

In this issue, F. R. Morris of Peterborough wins the Star Letter Award of a Maplin £5 Gift Voucher for his suggestions on training the Watchdog.

£5 MAPLIN GIFT VOUCHER

Star Letter

Dear Sir,

I was very interested to read the article 'Domineye TV Watchdog' (Issue 106). The unit would appear to be ideal for further development, as if I understand correctly, it is only activated when the dedicated channel is selected on the TV remote control. This would mean that it is not affording protection during normal TV viewing, or perhaps, 95% of the time. In the applications section of the article, it is suggested that one use could be to watch over a car in the driveway, but this would only be effective when the dedicated channel is selected. This relies purely on the occupier remembering to switch over, perhaps in the middle of an interesting programme on a 'catch as catch can' basis, thus leaving time span periods without camera protection. Trusting that I have understood the unit's functions correctly, it is suitable for further development to give continuous cover, especially during darkness. This may be achieved in different ways, viz:

1. The microphone in the camera, through the modulator, could be 'audio active', thus alerting the occupiers to noises outside.
2. With a PIR sensitive floodlight installed (as suggested in the article), this could be adapted to activate an audio signal or light sensing unit to display a warning signal built into the modulator, thereby prompting the occupier to switch to the dedicated TV channel.
3. Have the camera system emit an infra-red remote control signal when movement is detected, to switch the TV to the dedicated channel automatically.

I would be interested in your views and comments into the practicalities of these options. We already have a PIR operated floodlight, and this performs satisfactorily in illuminating the driveway but does not afford any indication to us during darkness and with the curtains drawn. You will gather from my proposals that they are intended to overcome this shortcoming by applied options.

A camera surveillance system is only effective if the people who are using it are vigilant themselves; even if a camera is monitoring a scene continuously, any action that takes place could be missed unless either someone happens to be watching the TV monitor at that instant, or a video recording is being taken (assuming the action is spotted when the video is replayed). The Domineye TV Watchdog (Order Code CD12N, £249.99) could be used in conjunction with a dedicated TV set, tuned in to show what the camera sees all the time, which would improve one's chances of noticing intruders outside, or the TV channel could be automatically switched over to the camera using the methods you mention. Your first suggestion, using the camera's built-in microphone to alert occupiers to noise outside could be problematical in noisy areas (e.g. near busy roads), with the likelihood of regular false alarms. Another possibility (a variation of your second suggestion) if you already have a PIR floodlight installed near the camera, would be to use a circuit that detects when the light switches on and passes on a signal to automatically switch the TV to the dedicated channel – or to activate a warning lamp/sounder. The Slave Flash Trigger project (Issue 98 – Order Code LP57M) could be adapted to provide this function. This would avoid having to tamper with existing mains wiring and potentially upsetting the operation of the PIR floodlight, since no direct connection to it would be necessary. Using the system to transmit an infra-red signal to automatically switch to the dedicated channel (as per your third suggestion) would be a good method, assuming you could generate the correct infra-red remote control code in the first place – perhaps a 'One-For-All' universal type remote transmitter (e.g. BV21X) could be adapted to achieve the channel switching. The Domineye system may also be used to check on callers at your door prior to you opening it, in which case, of course, you simply switch to the dedicated TV channel on hearing the doorbell or knock on the door. Alternatively, if you have dogs, you could rely on them to detect the presence of someone outside (they're remarkably effective at it!) and switch to the camera channel when you hear them barking. The dogs could then be let loose to see off any unwanted visitors.

The Generation Game

Dear Sir,

I have just read with considerable interest, C. T. F. Collett's letter on the 'gas technology of yesteryear' (Issue 107). I am referring to the extracts of the Milnes brochure for the thermoelectric generator, powered by a domestic gas supply. I am researching in the field of thermoelectrics at the NEDO Centre for Thermoelectric Engineering, University of Wales Cardiff, the largest research group of its kind in Europe, and possibly the world. Our research team have led the way forward in this field for many years, in all aspects of thermoelectricity from materials to systems. We are very interested in the information on this product, despite its age, and would appreciate it if you or the author could forward us with a copy of the brochure. This would not only be useful to our research literature, but as an interesting display item at our research centre. Perhaps you may wish to visit our research group homepage on the Internet, at **`http://www.cf.ac.uk/uwcc/engin/gao/page.html`**. Though still under construction, it gives an insight into this exciting field of technology.

Dr. Simon G. K. Williams,
Research Programme Co-ordinator,
NEDO Centre for Thermoelectric Engineering, University of Wales, Cardiff.

Copies of the Milnes brochure have been passed on to Dr. Williams. Once again, thanks to C. T. F. Collett of Waterlooville, Hants, for supplying us with the brochure. Who'd have thought that a humble advertising leaflet could generate such interest after all those years?

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Organised and Computerised

Dear Sir,

I read with interest, the article by Alan Simpson in the October 1996 issue of *Electronics and Beyond*. The article centred on the use of computers at 'Granada Studios Tour' at Manchester and misses completely one use of computers at Granada that links modern computer technology to the past; this is one of the aspects that the Granada Theme park is all about. The Lancastrian Theatre Organ Trust (LTOT) has, on behalf of Granada, installed the ex-Gaumont Manchester Wurlitzer pipe organ in the Projections complex within Granada Studios Tour. To fit in with the operation of the Tours complex, the organ has been computerised and now has more computer control than any other pipe organ in Europe. The computer system used was developed as a special by Dick Wilcox, who lives in California, USA. Wilcox founded the Alpha Micro Company, and he was responsible for the design of the computer systems and software that were used in the American Space programme and were incorporated in both the US Lunar Lander and the Mars probe. The software used at Granada was all downloaded over the Internet from Dick Wilcox in 1990 before the Net became as popular as it is today. The computer hardware uses a centre core computer with a distributed telemetry system to control the 1,100 pipes in the organ. Much of this hardware was put together using the services of the Maplin shop in Manchester. Within the next few months, The Lancastrian Theatre Organ Trust will be removing the large Wurlitzer from the Free Trade Hall in Manchester to commence the task of total restoration of the organ, a part of which will be the computerisation of the organ control system. This Wurlitzer is one of the largest series of Wurlitzers built, there being only 14 in the series, and the Manchester organ was one of only two of this size and design to ever have been exported from America, its sister organ being in the State Theatre, Sydney, Australia. The sheer size of the organ presents many problems for its computerisation; the Trust is discussing the project with Dick Wilcox and his associates at the moment, in readiness for the commencement of the project early next year. The new home for the Wurlitzer will be within 1 mile of one of the newer Maplin shop, which we are looking to for supply of parts. Again, the Internet has proved invaluable in its ease of communication capabilities during the specification of the computer and will be used for software transfer as the project develops. This again will show the use of modern technology to link with the past and bring the sounds of the past to a present day audience and, we hope, to the audiences in the next Century.

Don Hyde, Vice Chairman LTOT,
Stockport, Cheshire.

Good luck with the restoration and computerisation of the Wurlitzer. Nice to hear that Maplin will play a part in the revival of this classic instrument.

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Over Cooked?

Dear Editor,

It is with regret that I have decided not to continue my subscription to *Electronics and Beyond* with effect from the date of this letter. I feel it is only fair to give you my reasons, so here goes. I have in front of me the October issue. My main interest is in building things, so the projects/circuits ideas are the main reason for buying the magazine. Taking the four projects. The regulator kits I could build with my eyes closed (almost). The aerial will be of interest to those 'overhearing' other peoples conversations – not an interest of mine. The Active Transformer DI box is the only real project in my opinion. Unfortunately, I am no musician. I suggest you take a look at the magazine and ask yourself the following questions.

1. How much of the magazine is directly to do with Electronics? That is, actually electronic theory/construction and how much is consumer electronics related. Is there too much of the latter? Far too much in my view!
2. Are the projects likely to appeal to a broad range of abilities and budgets? NO. In my view, the last interesting project was your Valve Amp. No, I did not build one but reading about it was useful research as I eventually designed and built my own (I'm listening to it now).
3. Is the information in your magazine already covered by other magazines in their own fields? By this, I mean the astronomy articles. Interesting though they are, I already buy them via *Astronomy Now*.

I think if you answer these questions honestly, you will agree that the magazine has become too generalised and not really of direct appeal to the constructional enthusiast. Maybe this is what you want. It will save you time developing projects. If this is the case, I wish you every success. If this is not your aim, ditch the articles on consumer electronics, develop some more imaginative and, if needed, complex projects. I shall still peruse the magazine in WH Smith.

J. C. Cooke, Bovingdon, Herts.

Paul Freeman-Sear, Publishing Manager replies:
Thank you for your comments. You see, we do publish letters of criticism. Let us stand back and take a look at what has been happening to the business of amateur electronics. Enthusiasts and appropriate magazines for constructing radio sets have been around for a very long time, some sixty to seventy years in fact, but it was only in the early '60s that 'practical electronics' took a hold. The hobby probably peaked for the magazine business around 1980. These were boom years for the industry, with no shortage of very creative constructional projects, particularly in the audio field. However, the 1980s saw two principal events happen that would alter the hobby. Cheap, good quality, mass manufactured electronic products were being exported from Japan to satisfy the insatiable demand for high tech products. The constructor was then tempted by the ease and convenience of a complete working product and indeed, was able to buy the product cheaper than could be constructed. The second event and some say a revolution, was the effect personal computers had on our lives. Witness the number of computer titles on the shelves around now and compare with what was available in 1980. The electronics enthusiasts' attention had been attracted away and on towards a high level of involvement that computer software demanded. Another point to ponder on. There was everything, it seemed, that one could create electronically in the '60s and '70s. Now, contributors find it very difficult to come up with something new. There is also a shortage of young contributors to the business. Could this be they have been attracted elsewhere? This decline in so-called interest is across the board and has affected all magazines in the sector. We at Maplin are taking a long hard look at the hobby electronics sector. There are many new avenues for us to explore and we will certainly try to find and present new and creative ideas for constructors as soon as they become available. Maplin aim to move with the times and we are always interested in your ideas on the practical aspects. You have not been forgotten.

A merry christmas to all our readers from Britain's best magazine for electronics

THE MAPLIN MAGAZINE ELECTRONICS and Beyond

REVIEW

Apple Newton PDAs PDQ?

Reviewed by Martin Pipe BSc AMISTC

Towards the middle of 1993, the world's first Personal Digital Assistant (PDA) arrived in the UK. This was the Apple Newton, an extraordinary hand-held device that allowed its owners to take notes with a pen stylus, make sketches, organise themselves with an electronic diary, or even (with a credit card-sized PCMCIA fax/modem and a phone line) send faxes or e-mails. A menu-based GUI (Graphical User Interface) made the device easier to get to grips with, but Newton became famous mostly because of its handwriting recognition capabilities. Scribble a note on its screen with the stylus, and if the machine has been trained with your handwriting style, your words will be converted into text that can be printed, faxed or transferred to a personal computer. At the time, the Newton was revolutionary, and both product and concept certainly lived up to Apple's innovatory reputation.

Unfortunately, it was expensive (£650) and the handwriting recognition failed to live up to expectations, some called it an expensive Etch-A-Sketch for the computer age. An unsubstantiated rumour recently circulating around on a CIX on-line conference said that three hundred thousand unsold Newtons ended up in a Californian land-fill site. Other companies did start producing PDAs, including Sharp and Casio. Even Amstrad got in on the act with the 250 PenPad. Licensees of Apple's Newton Technology' include Sharp, Panasonic and Motorola. Sharp's PDA, the 1993 Expert Pad, was in fact a re-styled Newton. Since 1993, things have gone rather quiet; in the years since the Newton's introduction, Apple has been its only major hardware supporter. Over 50 (mostly) American software companies have grown around the Newton, most concentrating on specialist applications such as medical data collection.

PDAs are not seen as universal replacements for notebook PCs. Notebook PCs can run universally-available and familiar Windows and DOS applications directly, and with pretty much the same functionality and speed as today's desktop machines – but with the added advantage of portability. With GSM phones and data cards, they can be used to send faxes and access the Internet, although data throughout rates are poorer.

Notebooks, however, are just not as portable as PDAs. You cannot put, at least for now, a full-spec notebook in your jacket pocket. Any such device could never have an internal floppy drive, due to limitations of size. Although hard disks are getting smaller and smaller, chances are they will be replaced by non-volatile memory cards for such uses.

For jotting down ideas on the spur of the moment, it's simply much easier and quicker to pull out a PDA, or a device like a Psion 3a; how many of us carry around notebooks with us for most of the time? The Newton's ideas jotter is called 'notepad' and will be, for most of us, the most-used application. PDAs also provide quick access to schedulers (in the case of the Newton, the to-do list and datebook), address books, clocks and calendars. Such devices are much easier to use and more accessible than their PC equivalents. PDAs are frequently being used as data collection devices for more powerful machines, as well as personal organisers.

Newton Applications and Software

The medical field is one in which the Apple Newton is proving popular, and so far hospitals in Germany and the US have embraced it as a mobile data capture device. In the German example, a program developed by a local company is being used to capture operational or service data in the field of outpatient nursing. The hospital, in Cologne, has 50 MessagePads, which form part of a much larger system that handles areas as diverse as operations management

and accounting. The Newton's GUI-based user interface makes it easier for staff, without computing experience, to understand. Other Newton third-party software products include applications for expense tracking, personal financial management, teaching, GPS (Global Positioning by Satellite) integration, pharmacy data collection, vehicle organisation, scientific maths and sales automation.

There are even music composer and golf programs jostling for your attention – Newton software is not all spreadsheets and contact managers.

Apple also has an Internet Enabler; basically, a TCP/IP stack that supports standard transfer and 'messaging' protocols including MIME, SMTP and POP3. Some companies are already releasing basic Web browsers and e-mail packages for the Newton. On Apple's Web site `http://www.apple.com`, you can find a CompuServe access package for downloading and transferring to your Newton. It is true, that with a cellular phone and data card, Internet access has never been so portable. You can surf the Web on the train to your heart's (and the network's) content, or at least until the cellular signal momentarily drops and the connection is lost!

Apple also produce software, for the Mac and PC platforms, known as Newton Press. This is an electronic publishing tool that creates electronic documents (similar, in principle at least, to the Adobe Acrobat format) for reading' on Newtons. Such documents could include graphic files (pie charts, for example), spreadsheets and word processing files. Designed primarily for business users, Newton Press is intended to be a method of distributing travel routes, meeting agendas, reference books (such as repair guides) and phone lists among clients, suppliers and employees.

Newton Technology

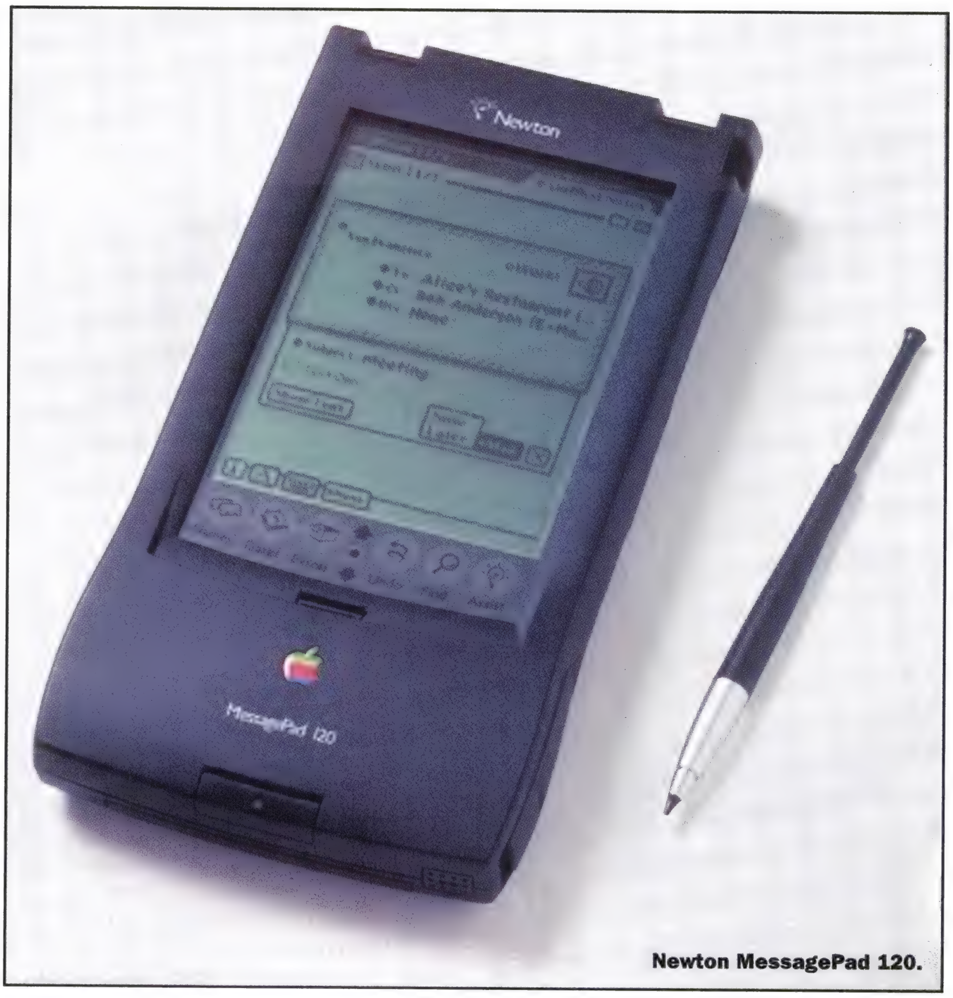
But what of the Newton's inner workings? Apple's Newton Technology encompasses several areas. The first, the communications architecture, provides a number of ways in which data can be transferred to and from the machine. Newton is certainly well-connected. There's an infrared transceiver, primarily intended for one Newton to talk to another; in business, an application of this is the exchange of electronic business cards at a meeting. Newer PC motherboards and notebooks support the connection of an infra-red transceiver that conforms to a standard developed by Hewlett Packard; unfortunately, the data format of Newton's version is incompatible.

But fear not, another option is the RS232-compliant serial port, which on other personal organiser products is normally a rather expensive option (but then again, Newtons are themselves rather expensive devices to start off with!). The serial port, which conforms to RS232 as well as Apple's LocalTalk standard, is intended for the interfacing of printers, as well as personal computers (and non-PCMCIA modems). Since this is an Apple device we are talking about here, any printer attached to Newton needs to support Adobe's PostScript standard, a legacy from the Mac. To print to a non-PostScript device, you will need to get the document into your PC first, and print from there. Finally, we have a PCMCIA Type II slot for the accommodation of memory cards and fax modems. The communications architecture has been designed to support data, fax and e-mail. Web browsing has recently been added to this list.

The second area of Newton Technology, the information architecture, is centred around an object-oriented universal database that stores any kind of information entered into the device. The Newton does not use files and filing systems in the way that conventional computers use them; instead is this common pool of data available to all of the programs that need it. Apple has created a Newton Toolkit so that programmers can work in this unfamiliar territory, and produce applications for the platform.

Programs are transferred to the machine from a personal computer via the serial lead; it is assumed that Newton users have a PC or Mac. Using a desktop machine also makes the downloading of programs and updates from the Internet, or bulletin boards, easier and safer (they are always on your hard disk, should you need to re-transfer them to the Newton). Programs could also be burnt into PCMCIA memory cards. Unless the complete program is loaded into the Newton's memory in one go (so that the card can be removed) the slot will no longer be free to accommodate a modem.

Newton Technology's third area, the recognition architecture, is the most interesting. Handwriting, whether printed, cursive (i.e. joined-up) or a mixture of the two, is recognised with the assistance of a 93,000 word vocabulary. There is also the option to define 1,000 of your own words in a custom vocabulary, which is useful for specialist applications such as medicine, science and engineering. The Newton's recognition architecture also supports various intuitive short-cuts. For example, crossing out an item of text with a four-stroke zig-zag will delete it.



Newton MessagePad 120.

Training the Newton to recognise your handwriting style over a period of time is important, and the Newton will support a guest user as well as the main one.

Sketched drawings also benefit from Newton's recognition architecture. Lines are straightened, and circles made perfect, helping to neaten up your ideas. There is also a series of pop-up keyboards, including a typewriter. The latest release of the operating system, Newton 2.0, was released towards the end of 1995 to answer criticism of the original software's handwriting recognition capability. Interestingly enough, Newton 2.0 provides support for a full-sized keyboard that connects to the PDA via the serial port. According to Apple, this keyboard is intended to allow customers to input data quickly. Apple's research had shown that a subset of Newton customers had required keyboard input for drafting e-mails and reports, as well as typing up meeting notes.

In the area of hardware, Newton is based around powerful and efficient RISC processors developed in Cambridge by ARM (Advanced RISC Machines), an up-and-coming microprocessor designer in which Apple has a major interest. ARM is credited with producing devices with among the highest MIPS-per-watt ratings of the industry. The Newton MessagePad 120 makes use of an ARM610 processor that runs at 20MHz, as did the original model.

An ARM spokesman hinted that future Newton products could make use of the latest StrongARM, a next-generation RISC processor that would provide the power needed to speed up handwriting recognition, and maybe facilitate voice input (dictating to your machine via a boom mike, as you currently can with IBM's VoiceType or Kurzweil's Voice, is certainly an attractive position). The processor is complemented by an Apple ASIC chip, a slice of non-volatile RAM (around 2Mb in the case of the 120, of which just over 1.3Mb is available for user applications) and a healthy 8Mb of ROM, which contains the operating system (in this case, Newton 2.0). There is also hardware support of the LCD display, serial port, infrared device and PCMCIA slot. Low power consumption is an important area (hence the choice of a RISC processor) and the Newton offers power management facilities. If nothing is pressed for a short period, a MessagePad will go into standby and conserve battery life.

The fifth and final area of Newton Technology is the assistance architecture, which Apple hopes will make operation of Newton easy and intuitive. Recent actions are correlated with items in the common database, so that it can guess the actions you might wish to take next (smart defaults). The assistance architecture is intended to help users complete repetitive tasks, including scheduling, reminding and finding, in multiple categories. It has been designed to work between, as well as in, application programs (whether from Apple or a third party).

MessagePad 120

The MessagePad 120 itself is typically Apple – sleek, comfortable, ergonomically well-designed and rather expensive (£425 + VAT). The LCD screen has a resolution of 320 × 240 pixels, and with dimensions of 9·6 by 7·2cm is very readable. Unless you are using the device under subdued lighting conditions, that is. Apple have not included a backlight, if you want this, you will need the (£499 +VAT) MessagePad 130 which is, apart from backlight and a little extra memory – identical. The display is not colour, and will not even display greyscale – it's line-art or text only, folks. When the device is not in use, the precious screen is covered by a flip. To use, a button at the front of the machine releases the flip, which folds away behind the Newton's back.

The battery compartment is also found on the back. The Newton runs on four AA cells, which could be alkaline or NiCd types (it seems equally happy with the 4·8V of the NiCds as it is with the dry cells 6V; buried inside the unit, there seems to be some kind of inverter, which can be heard whining). A few hours of battery life is promised, and a power gauge can be selected from a menu (there is also a low-battery warning). A separate 3V lithium battery powers the Newton's RAM chips when the main batteries are dead, or the device is switched off. Power up the Newton, and the display is just as it was when last used. The backup battery needs replacing roughly on an annual basis. Apple does not supply a mains unit/charger with the Newton, which is downright annoying considering the retail price.

On one side of the MessagePad is a control for adjusting the contrast of the display, and the on-off switch. On the other side is the PCMCIA slot and, hidden under a bung, the Mac-style mini-DIN serial port and DC power/charge connector. On this side is the storage hole for the telescopic stylus; press the bit of stylus that is exposed, and it is released. Since the stylus is pressed against the display to access menu functions or write data to the device, it is important to use only the one supplied. Using a pen or sharp object may scratch the finish. The infrared Newton data-interchange window can be seen on top of the MessagePad. Inside the MessagePad is a tiny speaker that yields an audible response whenever data is entered, or a function is accessed.

Null modem cables are supplied for Mac (mini-DIN) and PC (9 and 25-way D Connectors) interconnectivity, together with Newton Back-Up software. Unfortunately, the person who had the MessagePad before me had decided to delete some of the Windows set-up files; after un-deleting them and scanning the disks for viruses, the program did not work properly when installed under Windows '95.

It defaults to COM1, which is not very sensible since this is normally the port to which your mouse is attached! Consequently, the mouse hangs, and you have to use the keyboard to select the correct port before rebooting! The replacement software worked much better, indicating that the original files had been corrupted. I can not speak for how well the Mac software functions, since I have only just acquired one of these second-hand, and am currently obtaining the rest of the items needed to get it working properly. One can only imagine that, since it originates from the same people responsible for the Mac, it should function extremely well.

Some Newton software requires more memory to run than is available on the MessagePad 120. Memory can be added in the form of PCMCIA cards (Apple sell 1Mb, 2Mb and 4Mb types) but their usage prevents other cards, such as modems, from being plugged in. This effectively prevents the MessagePad 120 from running some of the memory-intensive Internet software that is available; you may need the 130 version if you are a dedicated surfer. Perhaps future generations of Newton products might feature a Type III slot (which will accommodate two Type II cards), or two Type II slots.

I would have liked to have faxed something with the Newton. Unfortunately, it did not recognise my Portable Add-ons (Psion Dacom) v.34 PCMCIA modem – so much for 'Plug and Play' (more like Plug and Pray').

Click on card, from the extras menu, and it simply tells you that no card is inserted. It looks like Apple is once again up to its old tricks, creating its own subsets of standards. Mac users will know that the MacOS SCSI hard disk formatting tool only works with Apple drives (which are, nevertheless, normally standard models from outside world companies like Quantum, with some subtle drive firmware changes).

To get non-Apple SCSI hard drives (or for that matter, CD-ROM drives) to work with Macs, you need to spend yet more money on third-party software tools (I have recently learnt this to my cost). Apple does have a list of approved peripherals, but if you have a device that conforms to what is perceived to be a universal standard, yet is not listed or does not work, it's extremely annoying. Incidentally, the official Apple fax modem works at 2400bps data, and 9600bps fax. The low data throughput puts this device in the Dark Ages, and makes it practically useless for Internet applications. A new, faster, card should be due soon, if it is not here already.

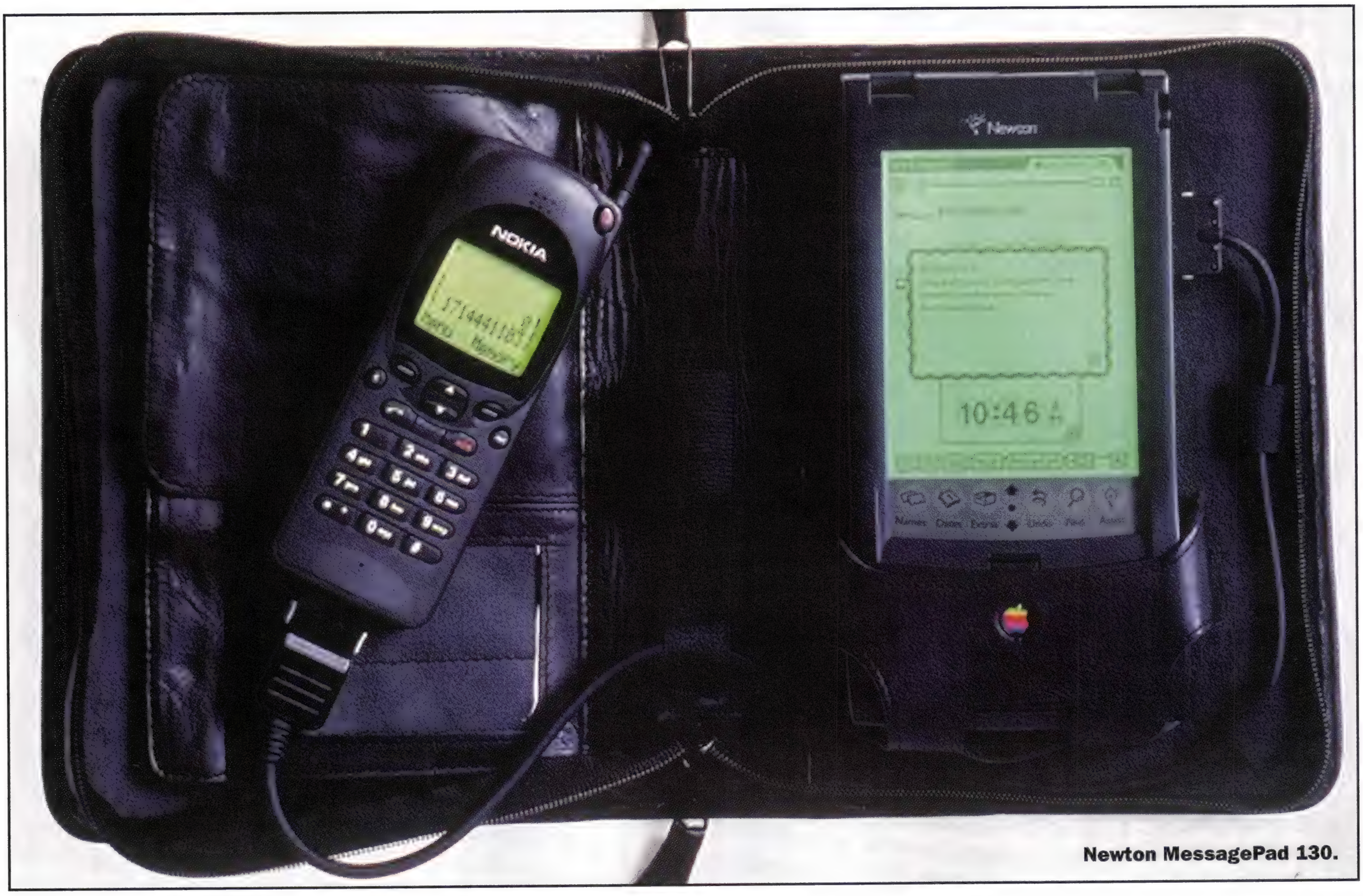
But back to the good. The Newton operating system is very nice, neat and user-friendly. Unlike some recent versions of MacOS, it appears to be very stable too. Notes are written on the screen, which has rulings akin to lined paper. Once you get to the bottom, it scrolls downwards and gives you more space to write. A bar at the bottom has touch-sensitive function buttons that provide instant access to what Apple sees as the most-used functions (such as 'undo', 'find', 'names' and 'dates'), and two arrows that allow you to scroll up or down the text.

Entering information can be achieved in three different ways. The first is to use a miniature on-screen QWERTY keyboard, the stylus is pressed against the character that you want. While accurate, this method is very time-consuming. The second is to hand-write it onto the screen without the MessagePad trying to recognise it. This system, in which your expensive Newton hardware is being used as a 1 spiral-bound notebook, is useful if you do not have time for the device to recognise your handwriting. I can imagine that storing information in this way is rather more memory-intensive than raw (i.e. ASCII) text would be. This system can be used, however, to quickly send handwritten faxes without the intermediate paper stage (you need the PCMCIA fax modem and a telephone line, of course). As an alternative to being transmitted, the information could be stored in user-definable folders.

The third method is, of course, handwriting recognition. When you first power up the device, preferences can be set. You can define whether your handwriting is printed or cursive, and set the spacing that you normally use between characters. A pen alignment function appears to detect whether you are left or right-handed. Finally, we have a section that puts a number of the most commonly-used shapes of each character on screen (you may see these shapes change as you use the unit more, and it becomes more familiar with your style), if your writing style is cursive. You simply inform the software as to the ones that you use most, sometimes and not at all. It certainly makes the handwriting recognition software's job easier. I would have liked a section where the Message Pad asked you to draw certain characters on screen repeatedly until it had learnt your signature. Instead, it does it on the job (provided that the 'learn my handwriting' option is switched on) which takes somewhat longer.

In this instance, the MessagePad accumulates information about your writing style, although this depends on you telling it that a word is incorrect. The correct word is selected from a word list, or a new word is defined using the on-screen QWERTY keyboard. Training is important, do not expect the MessagePad to start making sense of your handwriting immediately. It is important to keep your writing style consistent and neat. Unfortunately, mine is neither, and so myself and the MessagePad did not often see eye-to-eye (are they really selling Newton to the medical world – it must be very frustrating if you are a prescribing GP!), although I know of some people who have got on with their Newtons like a house on fire.

Recognising a word, and particularly one that you do not often use, can take some time, that ARM610 is clearly being pushed near its limits. This delay can stop your flow of words. More powerful processors will obviously help here. Handwriting recognition



Newton MessagePad 130.

is notoriously complex, and Apple should be applauded for the fact that it works at all. But then again, the Psion 3a's tiddly keyboard looks impossible to touch-type on until you have tried it. Some companies are developing alternative handwriting recognition systems. Palm Computing's Graffiti, one of the most popular, makes use of a completely new and simple character set. Palm claim that speeds of up to 30 words per minute and 100% accuracy can be achieved using it.

The 'extras' menu on the Message Pad gives access to various other functions available. It is from here that you can initiate connection to another device, access a clock/time zones, start up a simple calculator, choose fonts and other styles, and check received or sent messages. The 'dates' menu is pretty much an exact replica of a diary page, from here, you can jot down details of meetings, lunch appointments and the like. It is augmented by an alarm facility which will warn you just before the appointed event, and a 'to-do' function that lists all future events. A card-index style function, 'names', is an address book which can also contain fax numbers and e-mail addresses for use by communications programs.

In all, the way in which Newton's capabilities dovetail is impressive. At the end of the day, though, it is rather expensive (a second-user 486 notebook can be had for less) and perhaps should only be considered if you have a real need, and an understanding Apple dealer who will let you live with a MessagePad for a while on approval. These PDAs will definitely become more widespread once they hit the sub-£200 price point. The handwriting recognition is slow, although it is an improvement on previous Newton incarnations. Faster processors would help here, and facilitate the voice input that I see as being an important future data entry option for computer devices. The Psion 3a is cheaper and better-supported, but for sheer innovation it's the Newton that wins.

Contact

Apple Computer, 6 Roundwood Avenue,
Stockley Park, Uxbridge UB11 1BB.
Tel: (0800) 127753 (Freephone)

NEWTON MESSAGEPAD 120 SPECIFICATIONS

Price:	£499.38, but being discounted at most Apple dealers
Processor:	ARM 610 RISC, 20MHz
ROM:	8Mb, stores Newton OS
RAM:	687k system, 1361k user (non-volatile)
Connectivity:	PCMCIA Type II slot with 325mA supply capability, serial(RS232/Apple LocalTalk), infrared.
Display:	320 × 240 pixels, not backlit
Input device:	Telescopic stylus
Weight:	0·48kg (without batteries)
Battery requirement:	4 x AA (main), DL2032 lithium (RAM back-up)
Dimensions (WHD):	101·6mm × 29mm × 203·2mm
Fax support:	Group 3 (with fax modem, not included)
Backup utility system requirements:	386DX processor, Windows 3.0 or later (PC); 68030 or later processor, System 7.1 or later (Mac)
Optional accessories:	fax modem (2400 data, 9600 fax), full-sized keyboard, GSM connection kit, replacement pen, 1Mb SRAM card, 2 and 4Mb flash memory cards, interface for parallel-port printers, power adaptor (7V, 500mA), extended-life battery pack (takes 8 AA cells), charging station, rechargeable battery packs, carrying cases

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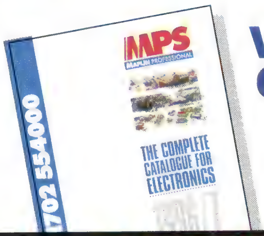

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Published Monthly

ELECTRONICS and Beyond

Touch Memory

THE KEY TO THE FUTURE

PART 2

Relay Board Project

by Tony Ellis

In the first of our Touch Key Hybrid constructional projects, I describe a highly versatile circuit – The Touch Key Relay Board, which enables a multitude of existing household or commercial products to be controlled by these ultra-high security touch keys.

In the following pages, we will see how to construct an incredibly low cost, high security door access system, followed by a touch key arm/disarm module that can easily be added to existing security systems – see Figure 1, showing the system block diagram. Remember, all these projects can be accessed/controlled by the same unique ultra-high security touch key! The circuit diagram of the Relay Board is shown in Figure 2.

The first application of the hybrid relay board is an incredibly low cost electronic door access system (see Figure 3) which still retains versatility and high security associated with touch memory, but which can be built for under £85. This is quite astonishing, as you would expected to pay in excess of £300 for a commercial high security access system. The system is based around the electric door catch release also sold by Maplin (Stock Code YU89W). As this device is essentially an electronic 'keep', the user has the option to use a standard type mortice lock if they prefer to still have a mechanical key. Obviously, higher security is afforded if a non-key door latch is utilised, and these are available from most good hardware stores. Also, if required, it should be possible to produce a simple standby battery back-up system for applications where mains power failure would pose a problem. A 12V 1·5A DC power supply is required and these can be found in a reasonably small adaptor type style (but be sure to double-check the current rating).

For this application, the relay board is programmed to 'pulse output mode' via link 'P' being made. IMPORTANT for correct operation, the PA link on the hybrid board MUST BE installed.

In operation, touching a valid key on the system's receptacle fires the door release for a few seconds, enabling the door to be opened. Once the pulse is complete, the 'keep' locks again, retaining the door again when it returns to its closed position.

The second application is to integrate the touch hybrid relay board into an existing alarm control unit (see Figure 4).

One big security advantage of this configuration is that the main alarm panel can be hidden. The only part that is required to be on view (accessed) is the touch receptacle itself, which as it is effectively a 'coded link', cannot be tampered with to bypass touch key operation. In conclusion, this configuration makes for higher security and a more attractive installation.

By way of an actual practical example, we will show full details of how to connect the hybrid relay board into a typical low cost, key operated, alarm system. Referring to Figure 5, it can be seen that the modification is simplicity itself, but please note, it would be advisable to meld the 24-hour (tamper) loop into the cable serving the remote-mounted zone select switch. Of course, the receptacle/indicator and zone select switch could be installed into the same remotely mounted box.

Circuit Description

The supply voltage applied to the relay board via the double terminal block must be within the range of 10 to 14V DC, as the board's relay has a 12V coil. The touch hybrid requires a +5V stabilised supply. This voltage is obtained by using a small 100mA regulator, RG1, with capacitors C1 & C2 providing decoupling. To prevent reverse polarity damage, diode D3 is included.

The relay pulses or toggles on/off, depending on whether link J2 is installed if C4 is shorted, then the hybrid divide-by-2 output is connected directly to the main relay driver (R2, D4 and Darlington-pair transistor TR2) giving a toggled output. If J2 is left open circuit, then an edge-triggered pulse generator circuit is formed via C4, D1, R4 and D2. Also, in pulse mode with J3 made, a pulsed link is formed via R2, TR1, C3 and R1, with the hybrid IGN line causing the passive arm function to be activated. This forces the hybrid's output line to toggle back to the hybrid's 'armed' state, after a short delay period.

PCB Assembly

Refer to Figure 6, showing the PCB legend and track whilst assembling the board. Removing a misplaced component can be tricky and may damage the component(s), so always double-check the type, value and polarity before soldering.

The sequence in which the components are placed is not critical. However, the following order is advised. Commence with the smaller, and progress through the largest. Install resistors R1 to R3, followed by D1 to D4; these have a band at one end to identify the cathode. Take care to insert the correct diodes, the 1N4148 being the smaller glass type. Next, fit the capacitors C1 to C4. The polarity for the electrolytic capacitors is indicated by a plus sign (+) on the PCB legend. However, the majority of electrolytic capacitors have their polarity designated by a negative (–), in which case, the lead nearest the symbol goes into the hole opposite to the designated hole.

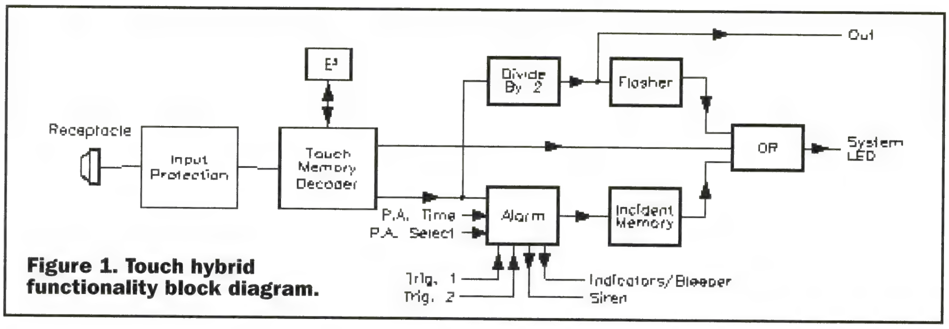


Figure 1. Touch hybrid functionality block diagram.

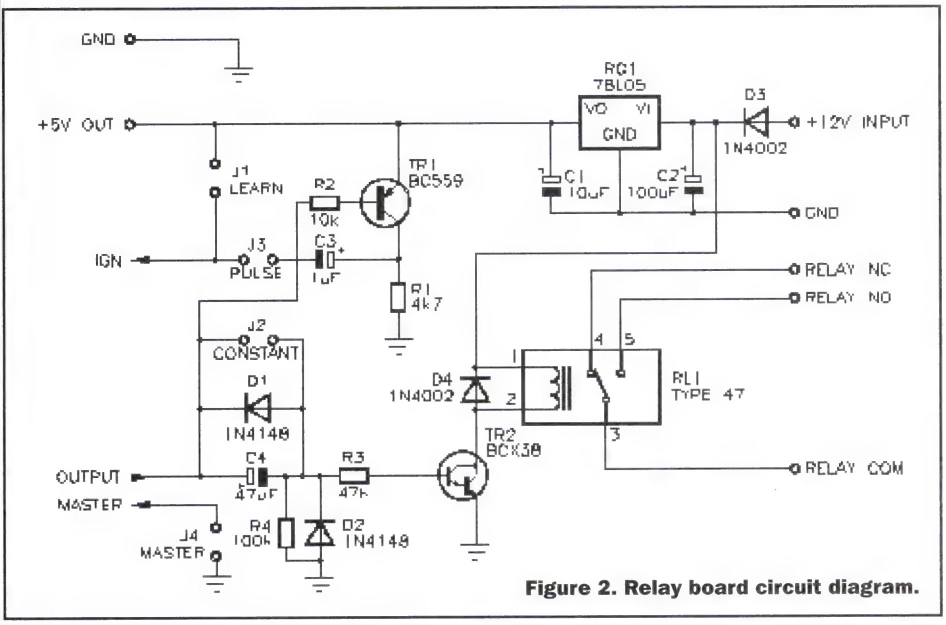
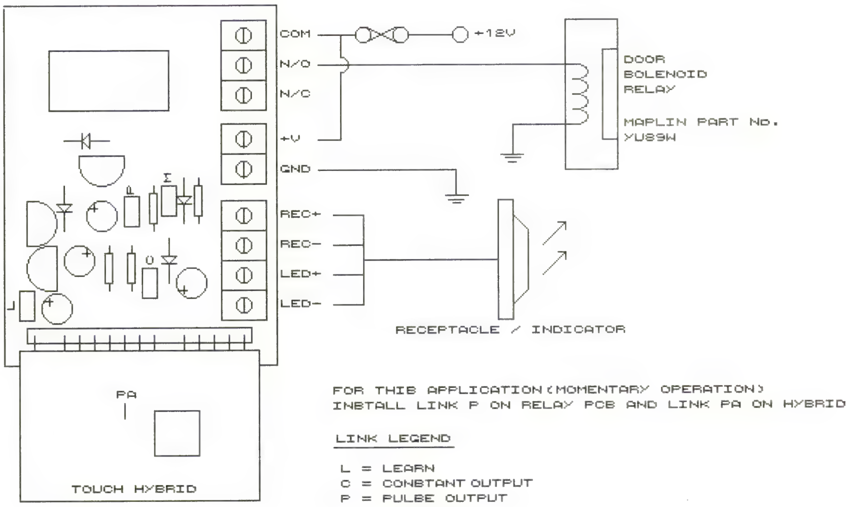


Figure 2. Relay board circuit diagram.



FOR THIS APPLICATION (MOMENTARY OPERATION)
INSTALL LINK P ON RELAY PCB AND LINK PA ON HYBRID

LINK LEGEND

L = LEARN
C = CONSTANT OUTPUT
P = PULSE OUTPUT
M = NOT USED

GENERAL NOTE

TO LEARN / LOCKOUT KEYS, INSTALL LINK L
LINKS P & C ARE OPEN CIRCUIT (USE JUMPER SUPPLIED)

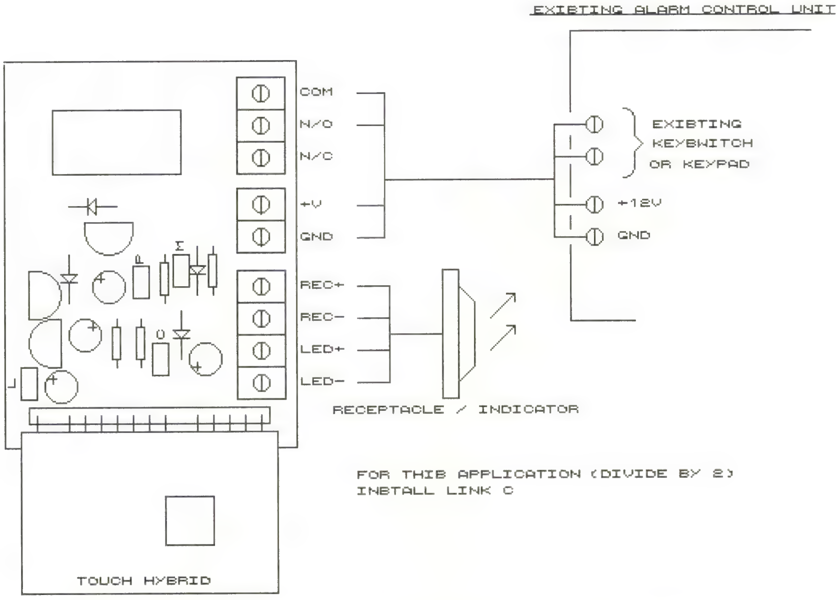
Figure 3. Low cost, high security access system.

Next, install the transistors Q1 and Q2 and voltage regulator IC1, making sure that its flat surface conforms to the package outline on the PCB legend, followed by programming link L1 to L4, followed by the screw terminal blocks (4-way, 2-way and 3-way). Finally carefully solder in the touch hybrid.

This completes the assembly of the PCB. Carefully check your assembly work, making sure that there are no misplaced components, solder bridges, or dry joints. Finally, remove any excess flux from the board using a suitable solvent.

Touch Key Learning Procedures

On powering up for the first time, the system LED goes on continuously. This means that the unit is ready to learn the Master Key. The first key presented to it is now the Master.



FOR THIS APPLICATION (DIVIDE BY 2)
INSTALL LINK C

Figure 4. Typical scheme to replace existing alarm system key switch or keypad.

Learn Master Key

Not necessary with Maplin Hybrid, as Master Key is pre-learnt.

Learn User Key

1. Apply power to hybrid relay board.
2. Install learn jumper (L) J1, remove links (C) J2 and (P) J3.
3. Touch Master key on receptacle, LED will flash at approximately 5Hz.
4. Touch Key to be learnt on receptacle, LED will go out.
5. Remove J1, hybrid will now switch on/off with keys.
6. Reinstate any links removed in step 2.

Repeat steps 2 to 4 to learn (teach) further keys.

Notes on Touch Key Technology

◆ There is a 4 second de-bounce period between accepting keys, i.e. after one key touch, a second will not be accepted for approximately 4 seconds. It is important to note that touch keys are meant for momentary action (i.e. touch and withdrawn); never leave the key in contact with the receptacle for more than a couple of seconds, as the output will toggle on or off or vice-versa. As a guidance, communication (to decoder) plus acceptance of an authorised touch key is generally in less than 100ms ($^1/_{10}$th of a second).

◆ The Master Key cannot be 'learnt' as a User Key.

◆ The unit can learn up to four/eight keys – the system always remembers the last four/eight keys taught to it. Selection of four or eight key mode is via the key no. program pads on the rear (non-component side) of the Hybrid, e.g. open circuit is 4 key mode.

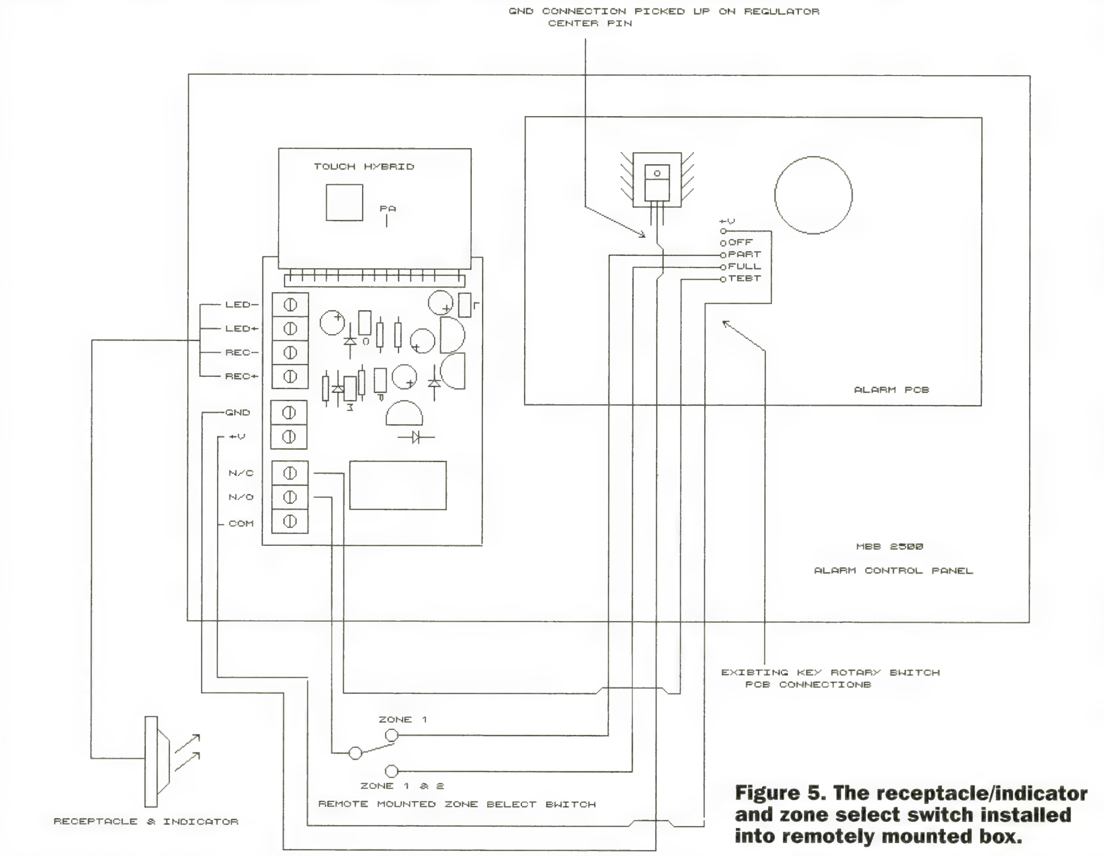


Figure 5. The receptacle/indicator and zone select switch installed into remotely mounted box.

- The same User Key can be taught to the systems more than once, this is a useful mechanism to 'lock out' lost keys. For instance, if the user wants the system to work off one key only, they can teach one key to the system four times, this will then become the only valid system key. Further, if the user wants two keys to be valid but to void a third key, then teach key one (once) and key two three times.
- After the Master Key has been presented, if no key is presented within 30 seconds, the system will revert back to its disarmed mode.

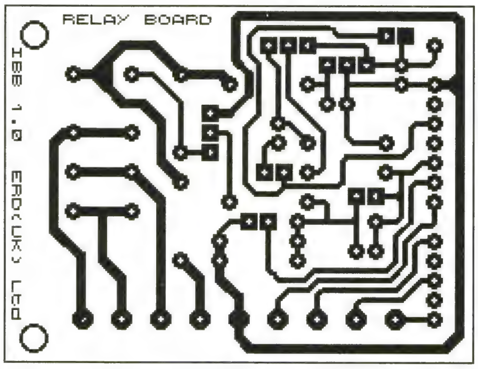


Figure 6a. PCB track.

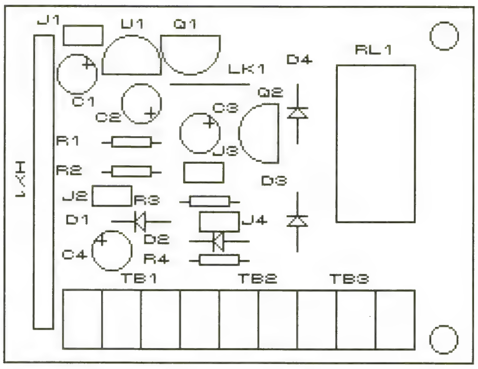


Figure 6b. PCB legend.

PROJECT PARTS LIST

RESISTORS (All 0·6W 1% Metal Film, Unless Stated)

R1	4k7Ω	1	(M4K7)
R2	10kΩ	1	(M10K)
R3	47kΩ	1	(M47K)
R4	100kΩ	1	(M100K)

CAPACITORS

C1	10μF 63V Radial Electrolytic	1	(AT77J)
C2	100μF 16V Radial Electrolytic	1	(AT30H)
C3	1μF 63V Radial Electrolytic	1	(AT74R)
C4	47μF 16V Radial Electrolytic	1	(AT39N)

SEMICONDUCTORS

D1,2	1N4148	2	(QL80B)
D3,4	1N4002	2	(QL74R)
TR1 (Q1)	BC559	1	(QQ18U)
TR2 (Q2)	BCX38 NPN Darlington-pair Transistor	1	
RG1 (U1)	78L05	1	(QL26D)
HY1	Touch Key Decoder Hybrid	1	(CK41U)
REC1	Touch Key Receptacle with LED	1	(CK44X)

MISCELLANEOUS

RL1	12V BT (Type 47) SPDT Relay	1	(DC80B)
TB1	4-way 5mm PCB-mounting Terminal Block	1	(KE55K)
TB2	2-way 5mm PCB-mounting Terminal Block	1	(FT38R)
TB3	3-way 5mm PCB-mounting Terminal Block	1	(RK72P)
J1-4	2-way Header Strip 2·54mm Pitch	1 strip	(JW59P)
K1	15-way Straight Pin Header (use part of 36-way strip, JW59P)		
LK1	22swg 0·71mm Tinned Copper Wire	1 reel	(BL14Q)
PCB	Ready made PCB (not available from Maplin)	1	

The Maplin 'Get-You-Working' Service is not available for this project.
The above items are not available as a kit.

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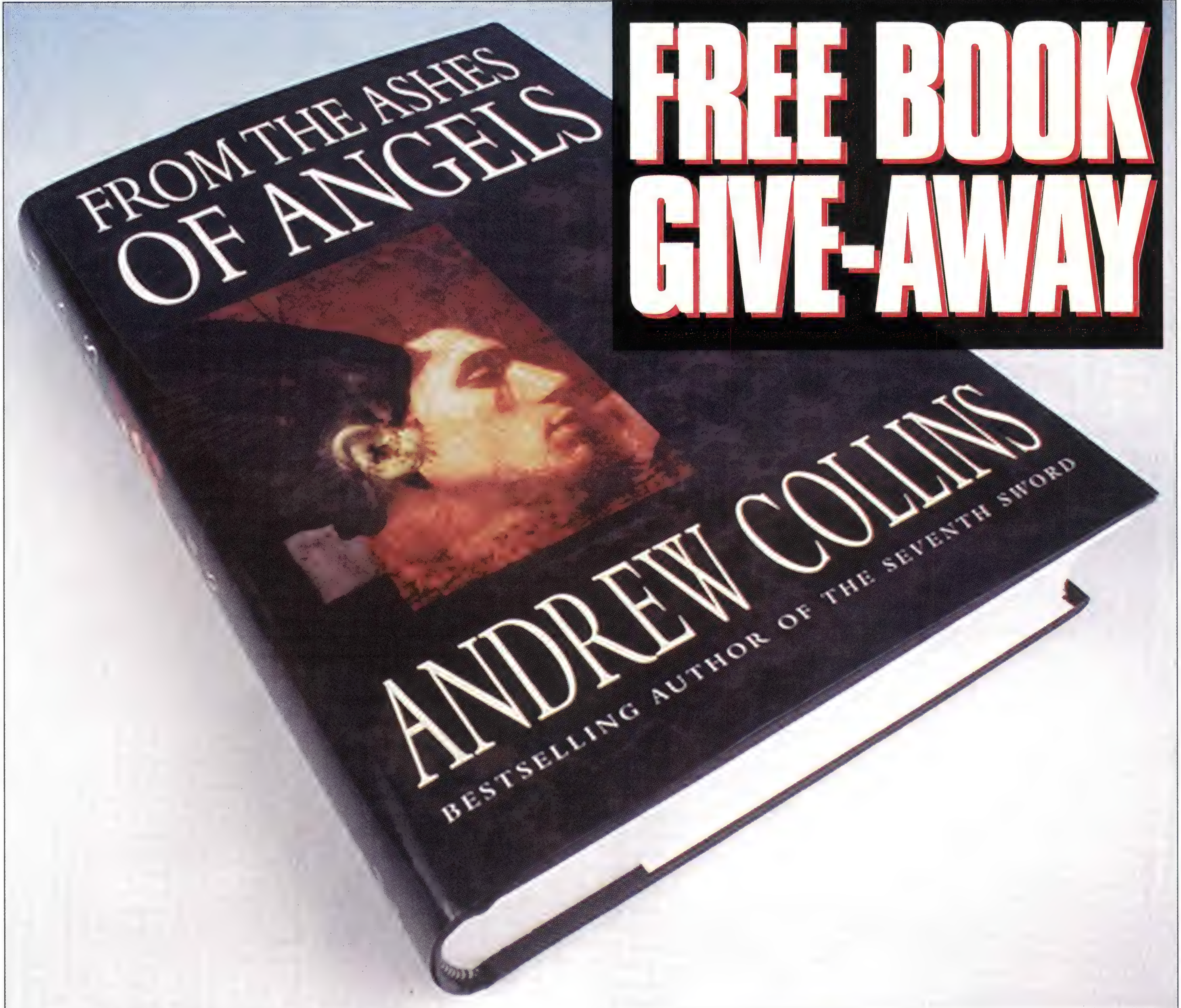

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> *Graham Hancock, author of* Fingerprints of the Gods

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The AC Power Supply and HOUSE WIRING

by Ray Marston

Ray Marston explains AC power distribution principles and looks at practical domestic AC wiring circuitry in this special feature

AC Power Distribution Basics

In all modern countries, national electrical power supplies are generated in extremely-high-voltage (EHV) 3-phase AC form (usually 50-60Hz) and are then distributed nationwide to the consumers via a network of cables and step-down voltage transformers. The network takes the basic form shown in Figure 1, which also shows (in brackets) the specific voltages that are used in the UK distribution system.

Thus, major power stations feed their 3-phase power into the *national grid* at 400kV, and individual *regional* consumer boards then tap into the grid via 400/132kV step-down transformers and distribute the 132kV 3-phase VHV (very high voltage) supplies to their own individual *district* consumer boards via VHV cable networks. The individual district consumer boards then tap into the VHV network via 132/33kV step-down transformers and distribute the resulting 33kV 3-phase HV (high voltage) supplies to their own individual district areas. These, in turn, further reduce the voltage via 33/11kV step-down transformers before further processing the supply and distributing it to *individual consumers* such as industrial, commercial, and domestic units within those areas. Note that this system is designed to minimise current-generated distribution power losses caused by the resistance of the distribution network's supply cables. Thus, an end-consumer who draws 1A (11kW) from the local 11kV supply will impose a drain of only 27·5mA on the national grid, which may derive its power (via cable) from a generating plant that is hundreds of miles away.

Figure 2 shows the basic form of a typical *area* AC electrical distribution path, in which HV supplies are distributed to various consumer groups. Thus, the 33kV supply that feeds the input of the area's 33/11kV step-down transformer may also be fed directly to heavy industrial units that have their own step-down transformer and power distribution systems, and the 11kV output of the step-down transformer may be fed to light industrial units that have their own AC power processing systems. The 11kV 3-phase AC distribution system is also fed to local commercial and domestic consumers via local sub-stations, which employ a step-down transformer to provide a '415/240V' 3-phase 4-wire output from the 11kV 3-phase 3-wire input.

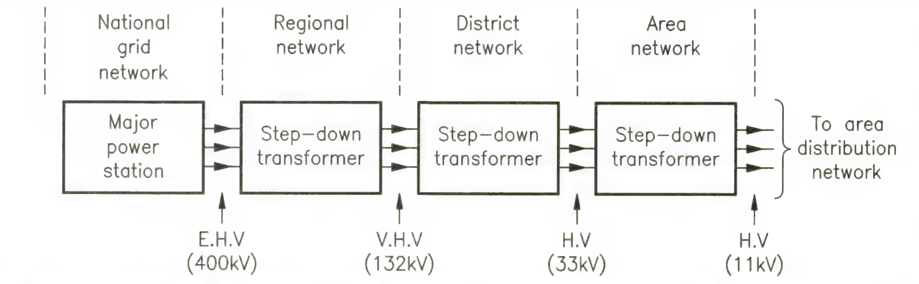

Figure 1. A single distribution path of a national AC electrical power distribution system (UK voltages are shown in brackets).

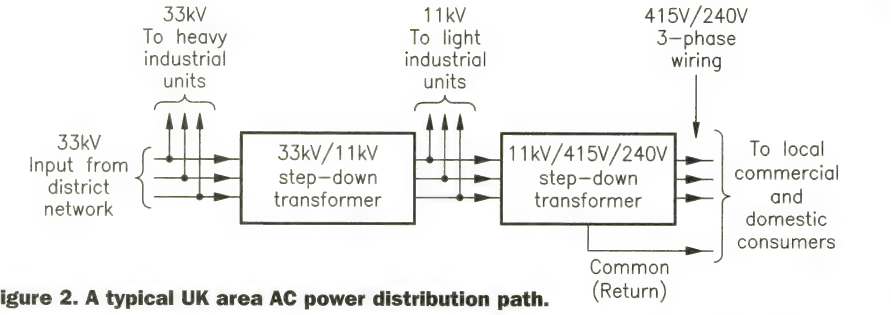
33kV To heavy industrial units
11kV To light industrial units
415V/240V 3-phase wiring
33kV Input from district network
33kV/11kV step-down transformer
11kV/415V/240V step-down transformer
To local commercial and domestic consumers
Common (Return)

Figure 2. A typical UK area AC power distribution path.

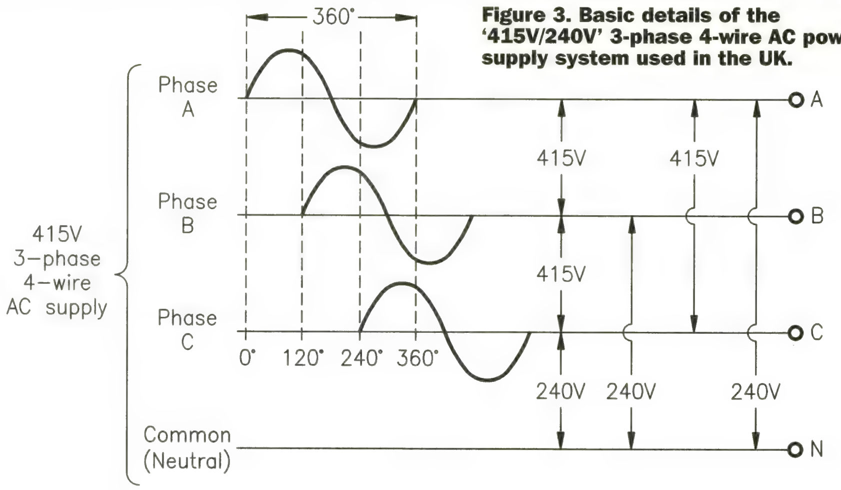

Figure 3. Basic details of the '415V/240V' 3-phase 4-wire AC power supply system used in the UK.

Figure 3 shows basic details of the above-mentioned '415/240V' 3-phase 4-wire AC power supply system. Important points to note here are that the AC voltages on the three supply lines are 120° out of phase with each other, that the rms voltage between each of the phase lines is 415V, and that the rms voltage between each phase line and the common (neutral) line is 240V. This type of system can thus be used for driving high-power 3-phase 415V electric motors by connecting the motor to all three phase lines, or can be

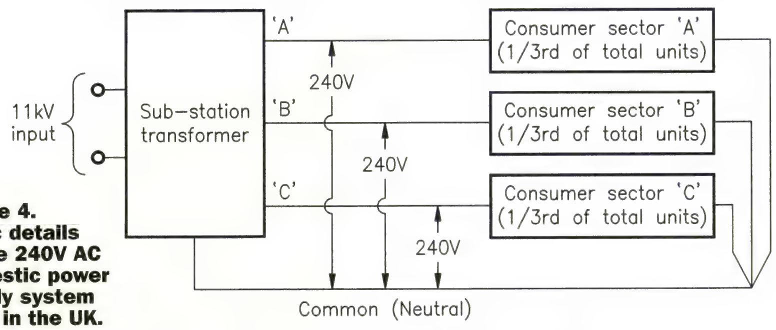
'A'
'B'
'C'
240V
240V
240V
11kV input
Sub−station transformer
Consumer sector 'A' (1/3rd of total units)
Consumer sector 'B' (1/3rd of total units)
Consumer sector 'C' (1/3rd of total units)
Common (Neutral)

Figure 4. Basic details of the 240V AC domestic power supply system used in the UK.

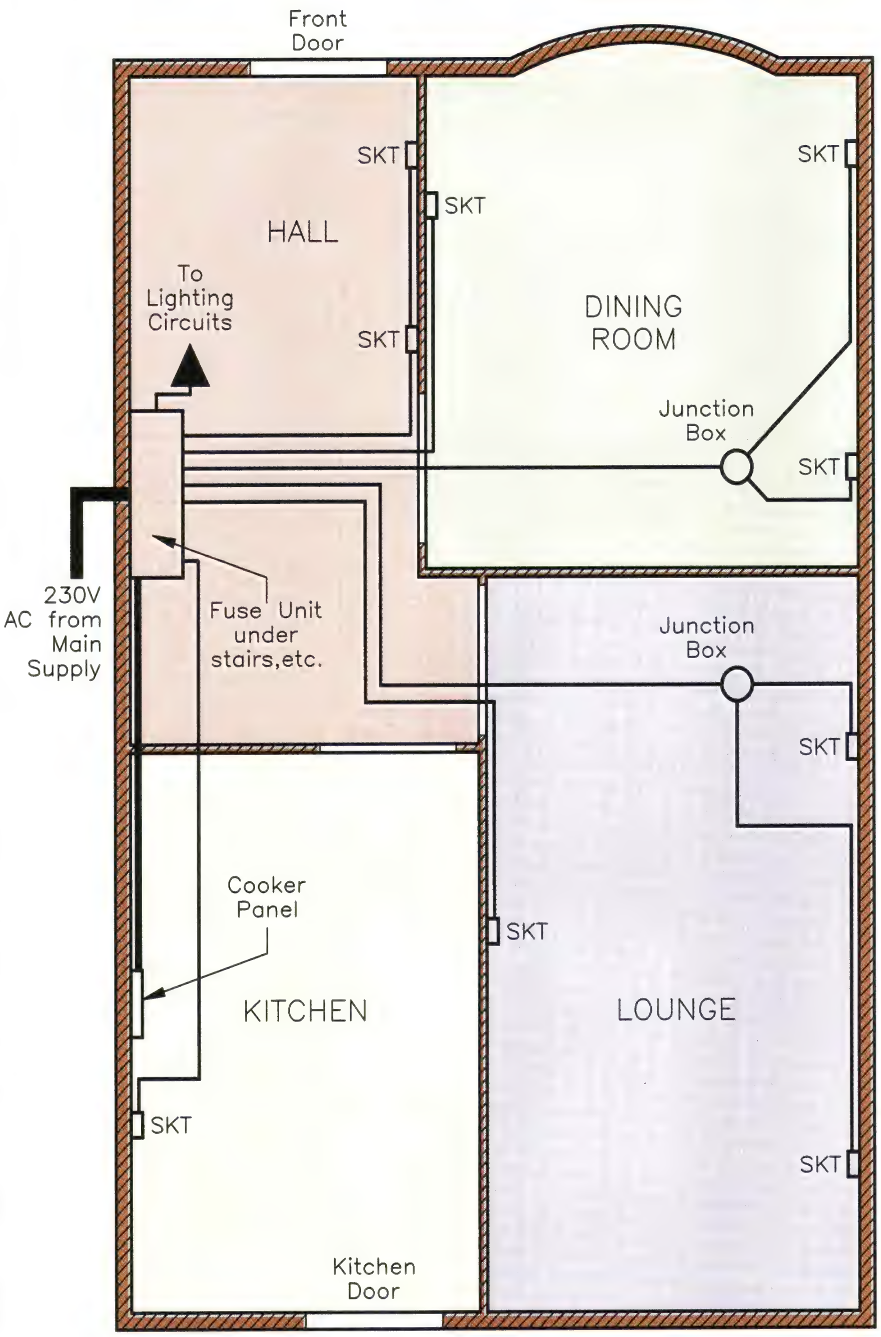

Figure 5. Typical old (pre-1947) 'radial'-style ground floor power wiring layout of a medium-sized UK house.

used to supply normal 240V AC power to domestic or commercial premises (etc.) via the common line and any one of the three phase lines.

One other important feature of the Figure 3 AC power supply system is that, because of the 120° phase shift that exists between the three supply lines, the sum of the three instantaneous voltages that appear between common and the three phase lines always equals zero. When, for example, the 'A'-line voltage is at its peak value of +340V, the 'B' and 'C' voltages are each at –170V, thus giving an overall sum of zero volts. Consequently, if identical loads are connected between each phase line and common, each phase line will supply an identical rms current, but zero rms current will flow in the common line. These simple facts form the basis of the normal 240V AC domestic power distribution system, which is shown in Figure 4.

In Figure 4, the area supplied by a local sub-station transformer is divided into three consumer zones or sectors, each of which consumes approximately one third of the total electrical units absorbed by the area. Each of these sectors is connected to the 240V AC supply provided by one specific phase ('A', 'B', or 'C') of the 3-phase supply, and via the sub-station's common line. Thus, if the system is perfectly balanced, the common line will always carry near-zero current, and if the system is severely disrupted (by the temporary removal of one complete sector from the system), the common line will carry a current no greater than that of the larger of the two remaining phase currents. Consequently, this basic 3-phase system allows any desired number of consumers to be supplied with a 240V AC single-phase 2-wire (plus 'earth') power supply, using only a 4-wire distribution system in which each wire requires a maximum current rating equal to one-third of the peak total current consumed by the system. This system is thus highly efficient in terms of power distribution costs.

Domestic AC Wiring Systems

Most ordinary houses are, as described above, provided with an ordinary single-phase AC power supply system. **In the UK, this is actually a 50Hz 240V supply that is regulated to within 6% of 240V (i.e., within the limits 224 to 256V), but is often called a '230V' supply to harmonise with the nominal 230V 'norm' of other European Community countries.** The supply is connected via a 3-wire *'phase, neutral* and *ground* (earth)' distribution network. A few large domestic premises (and many industrial units) are also supplied with a 3-phase 415V supply, for operating heavy-duty electric motors (for powering lifts, etc.).

In the UK, all 'modern' house wiring is designed to conform to safety regulations that were first laid down in 1947; these regulations have since been upgraded in fine detail, but are unchanged in essence. Thus, if you live in an old house that has not been rewired since 1947, it is probable that your old wiring has now reached a point where its rubber insulation has perished to the state where a total breakdown is imminent and the whole shambles is in danger of bursting into flames, and an urgent rewire – to modern standards – is probably required.

In all domestic UK buildings, electric power is fed into the house from the external 240V AC network and applied, via the building's electricity meter, to the individual household circuits via individual fuse units or, in modern systems, via a multi-fused *consumer* unit. The household circuits are, for convenience, classified as three distinct types, (a) power circuits (feeding power sockets, etc.), (b) lighting circuits and (c) accessory circuits (individual heavy-duty circuits feeding immersion heaters, cooker panels, etc.).

Old-style (pre 1947) electrical systems use a *radial* system of power circuit wiring, as shown in Figure 5. Here, each individual power socket or small group of sockets is treated as an individual circuit and is connected to the AC power line via its own specific fuse and length of 3-core cable; often, the phase ('live') and neutral lines of each circuit are individually fused. Such systems are inefficient; they require excessive amounts of cable and many fuses.

Modern (post-1947) UK systems of power wiring use a *ring* system of power-socket wiring. Figure 6 shows a typical example of such a system, in which the ring can be connected directly to the fuse box (consumer unit) or can be connected via a junction box, as shown. Here, a 3-core power cable is run from the junction box to the first (hall) socket, then sequentially to all of the sockets on (say) the ground floor and finally, back to the junction box again, so that a 'ring' of cable is formed. The ring is treated as a single circuit and provided with a single master fuse, but each socket plug is individually fused. Most modern houses are provided with two ring circuits, one to each floor. On the upper floor, the ring may be connected to the fuse unit via a junction box and feeder cable.

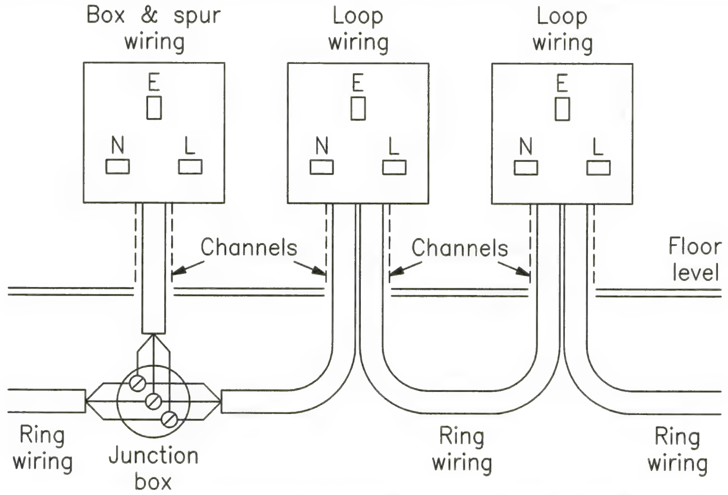

Figure 7. Alternative ways of connecting a power socket to the main AC power ring.

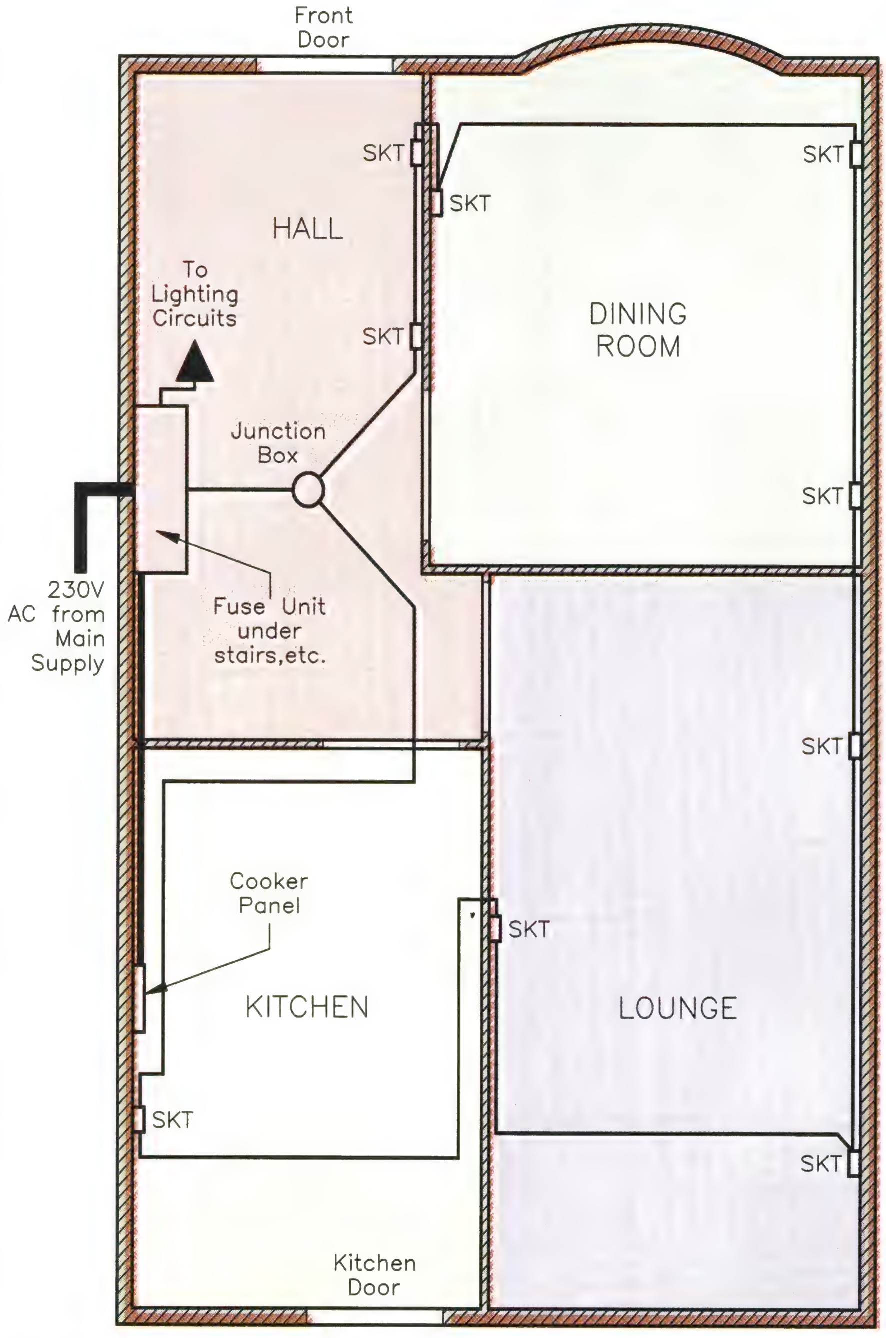

Figure 6. Typical modern (post-1947) 'ring'-style ground floor power wiring layout of a medium-sized UK house.

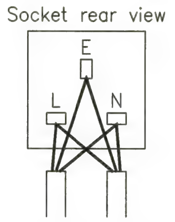

Figure 8. Basic way of connecting 'loop' wiring to a power socket.

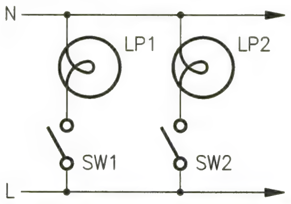

Figure 9. Basic domestic lighting circuit ('Earth' wiring not shown).

The ring system is very efficient in the use of 3-core cable. Power is fed to each individual socket via both sides of the ring, which are thus effectively wired in parallel and share the socket current. This factor enables a relatively light gauge of ring cable to be used. In practice, 2·5mm^2 PVC sheathed cable is used for most ring circuits, and any desired number of standard 13A sockets can be fitted to such a ring, provided that it does not serve a floor area greater than 100m^2; such a ring must be fitted with a 30A (maximum) master fuse and can handle up to 7·2kW. The feeder cable to such a ring (if used) must be a 4·0mm^2 type. Note that most 2·5mm^2 cable has a maximum current rating of only 20A, so if such cable is used to make a multi-socket 'spur' that is tapped into the main ring, the spur must be fitted with its own 20A (maximum) master fuse.

Modern Power Circuit Wiring

Rewiring the power circuitry of an average house to modern standards is a technically fairly simple task, but involves much dirty and hard work. Normally, the power ring is laid below the floorboards, and is connected to the individual power sockets by using either 'loop' techniques, or 'box- and-spur' techniques, as shown in Figure 7.

Before starting such a rewire, plan very carefully the precise layout of each basic wiring ring, and the desired number and positions of all of its power sockets. Flush-type sockets are fitted into special metal boxes, which must (usually) be set into a wall or plaster, in which a channel must also be cut to accommodate the socket's power wiring, which is fed upwards from the sub-floor power ring. The socket can be loop-wired into the ring by (1) making a loop in the ring's wiring, (2) feeding the loop up to the socket, then (3) cutting the loop so that two effective lengths of 3-core cable are available; finally, (4) the tips of the six 'cores' can be bared and wired to the socket as shown in Figure 8. Note that this loop technique requires two lengths of cable to be buried in the socket's wall channel; the alternative 'box-and-spur' technique (Figure 7) requires only one length of cable to be so buried, the other end of the cable being connected into the ring via a sub-floor junction box.

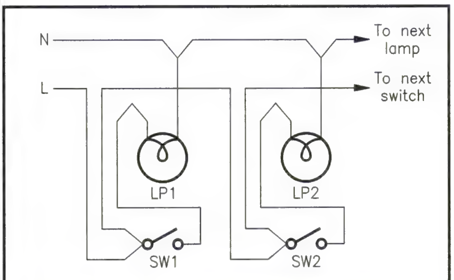

Figure 10. Old-style implementation of the lighting circuit (Earth wiring not shown), with three wires (plus Earth) running down to each switch.

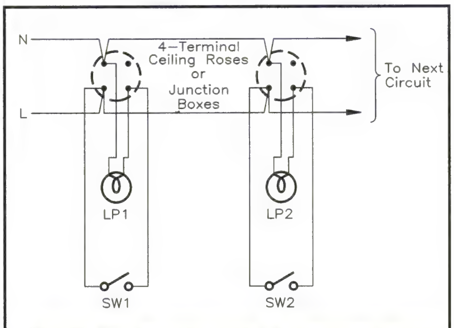

Figure 11. Modern-style implementation of the lighting circuit (Earth wiring not shown), with two wires (plus Earth) running down to each switch.

Modern Lighting Circuit Wiring

The basic AC lighting circuit of a domestic system is deceptively simple, as shown in Figure 9. Note in particular, that the light switch is used to connect the lamp to the live (L) side of the supply, thereby ensuring that an electric shock cannot be received from the lamp (when changing a bulb) when the switch is open ('off'). Also note that all lamp-plus-switch circuits are wired in parallel, across the supply lines, in 'radial' form.

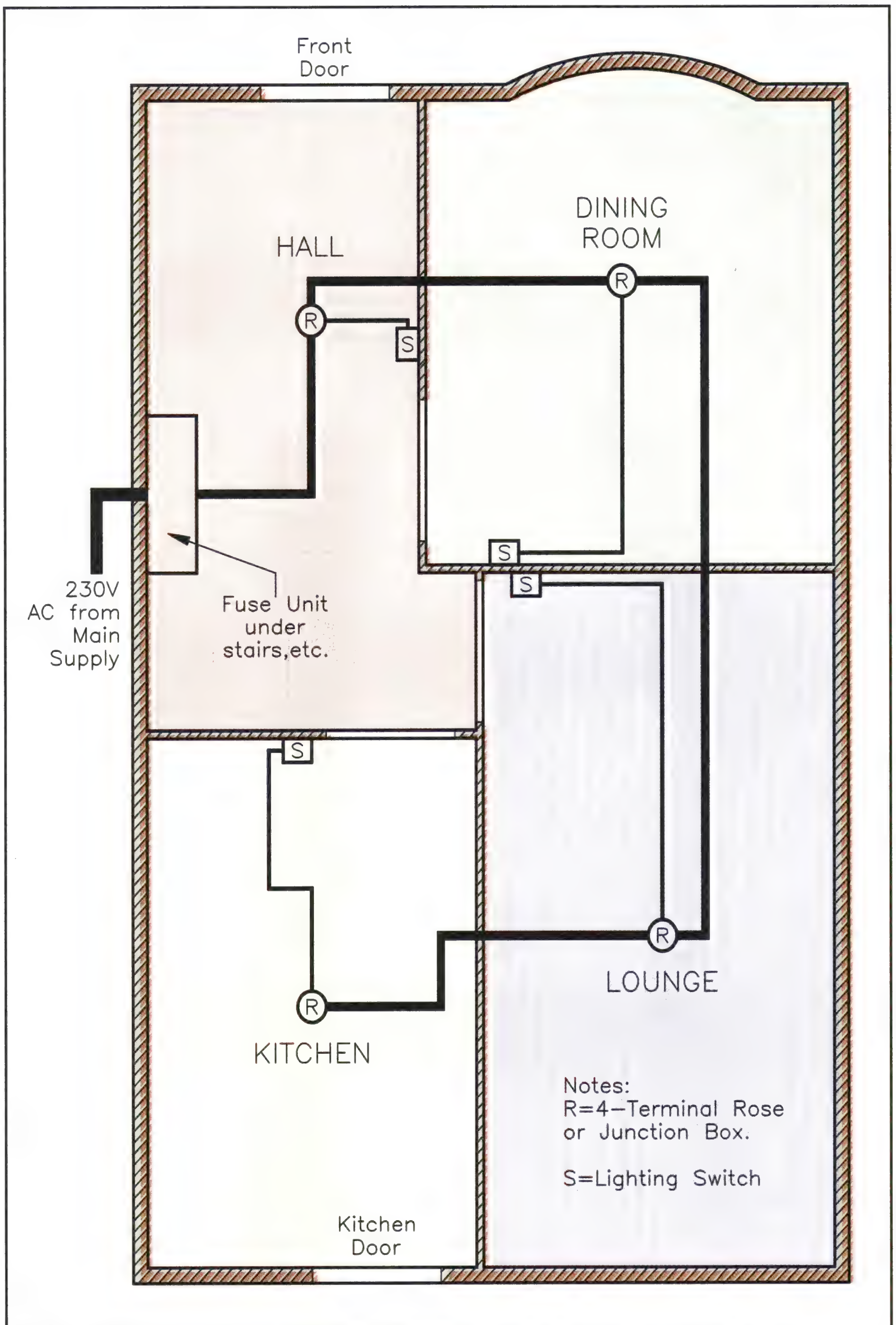

Figure 12. Basic modern ground floor lighting circuit of a medium-sized house.

The physical implementation of the Figure 9 circuit is not simple. Figure 10 shows the old-style (pre-1947) method of implementation, in which Neutral (N) goes to one side of each lamp and the Live line is looped from one switch to the next. Note that this method requires three wires plus Earth (E) to be run down to each switch. In practice, the old-style wiremen often ignored the 'polarity' rules and switched the Neutral line, so that the lamp socket remained permanently (and dangerously) 'live'.

Figure 11 shows the modern wiring method, which requires only two wires (plus Earth) to be run down to each switch. The system makes extensive use of 4-terminal ceiling roses or junction boxes. In practice, 1mm^2 3-core 'twin and earth' (T & E) cable is used for wiring most domestic lighting circuits.

Figure 12 shows (in simplified form) the basic modern ground-floor lighting layout of a medium-sized house. The power feed is taken from the main fuse box and runs, 'radial' style, to all the roses of the ground floor lights. Light switches are wired to the roses via additional cable. Once again, the system looks deceptively simple. In reality, the wiring to the roses runs above the ceiling; thus, the ground-floor's wiring must be laid by partially raising the carpets and floor boards on the first floor, and the wiring to the wall-mounted switches must be made by cutting suitable channels in the plaster, between the ceiling and the switches. Also, it is usual to apply multi-way switching (rather than switching from only a single point) to hall and landing lights, and this can be a very time-consuming task.

Figure 13 shows the circuit and implementation of 2-way light switching. In practice, 3-core 'twin and earth' cable is

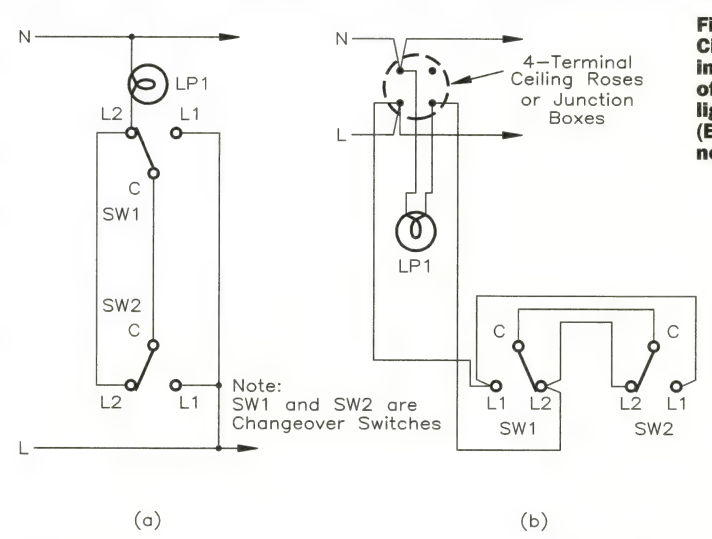

Figure 13. Circuit (a) and implementation (b) of modern 2-way light switching (Earth wiring not shown).

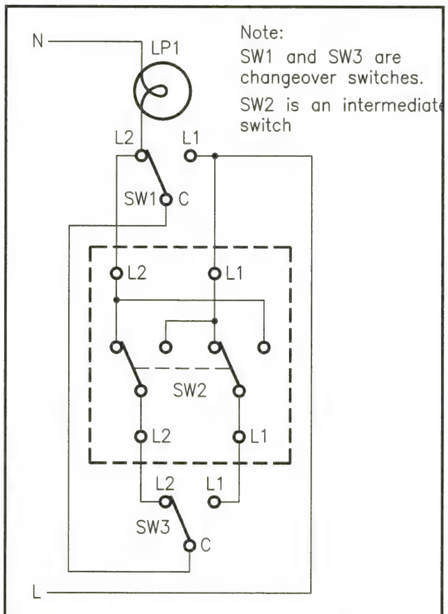

Figure 14. The electrical circuit used in modern 3-way lighting.

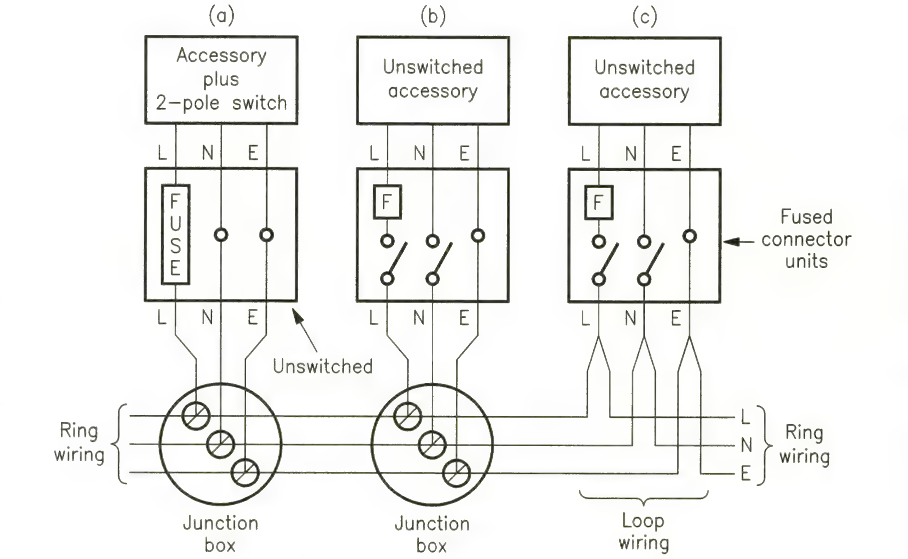

Figure 15. Three alternative ways of wiring fixed light-duty accessories into an existing ring circuit.

used to connect SW1 to the ceiling rose, and 4-core '3-core and earth' is used to interconnect SW1 and SW2, which are changeover switches. A lot of channelling work may be required to implement this system.

Figure 14 shows the electrical circuit involved in 3-way light switching, such as is often used in a hallway, in which the light can be controlled from either end of the hall and from an upper floor. This circuit uses two changeover switches and one standard 'intermediate' switch (available from most electrical retailers). This circuit is very time consuming to install and requires a lot of channelling.

Accessory Circuit Wiring

'Accessory' wiring is used for connecting fixed wired (non-plugged) appliances to the AC power supply, and comes in two basic types, being for either less-than-13A light-duty use, or for greater-than-3kW (= 12·5A at 240V) heavy-duty use.

Light-duty accessories include items such as electric door bells that are AC powered via step-down isolating transformers, electric clocks, small (less than 3kW) fixed electric heaters and fans, hot-air hand dryers, air extractors, and small air conditioning units or dehumidifiers, etc. Such units may be connected to the fused consumer unit via individual wiring spurs, or can be connected to one of the main ring circuits. In the latter case, the accessory must be connected to the ring via a fused connection unit (often called a 'fused spur unit') and must be controlled via a double-pole switch, which may be incorporated in the accessory or the connection unit, or may be connected in series with the wiring.

Figure 15 shows three alternative ways of wiring fixed light-duty accessories to an existing ring circuit. In (a), the accessory incorporates a 2-pole switch and is connected to the ring via a simple fused connector unit and a junction box. In (b), the unswitched accessory is connected to the ring via a fused connector unit that incorporates a 2-pole switch and via a junction box. In (c), the unswitched accessory is connected to a switched fused connection unit that is loop-wired into the ring circuit.

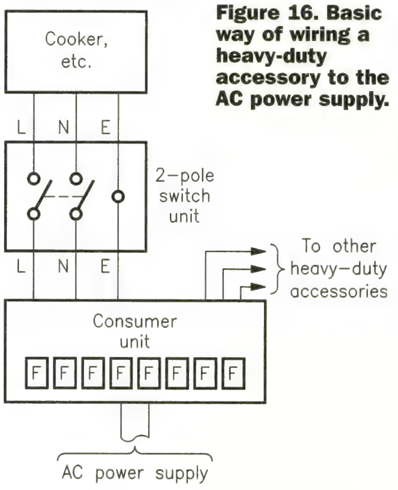

Figure 16. Basic way of wiring a heavy-duty accessory to the AC power supply.

Heavy-duty accessories include items such as electric cookers, water heaters, and storage heaters, etc., which must each be connected to the consumer unit via an individual wiring circuit and a 2-pole switch that is placed close to the accessory, in the manner shown in Figure 16. The circuit does not have to be individually fused, since overload protection will be incorporated in the part of consumer unit that feeds the circuit.

Practical Rewiring Hints

Electrical rewiring is a technically simple but physically arduous, dirty and time-consuming task that can save the keen DIY enthusiast a huge amount of money. To gain access to underfloor wiring areas, you will usually have to move lots of furniture, lift large areas of carpet, and raise several floor boards in each room. You will have to crawl about beneath the floorboards, and may have to drill holes through joists and beams to facilitate wiring runs. If you are adding new flush-fitting power points or lighting switches to a house, plaster (and sometimes bricks) will have to be

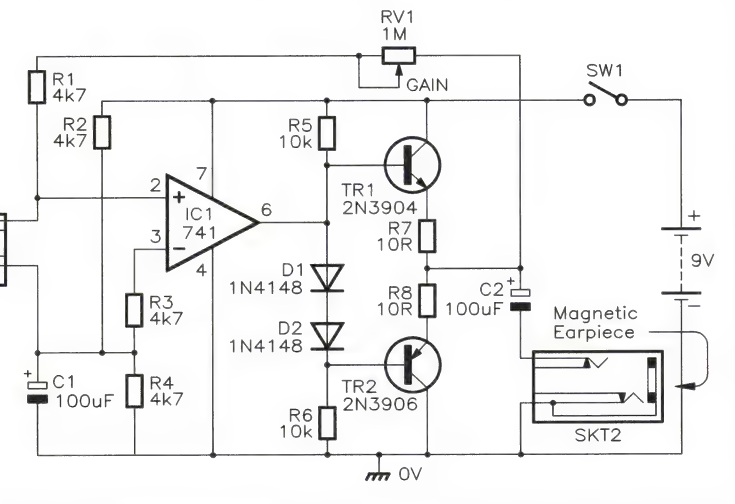

Figure 17. This wiring tracer works on the magnetic-field detection principle.

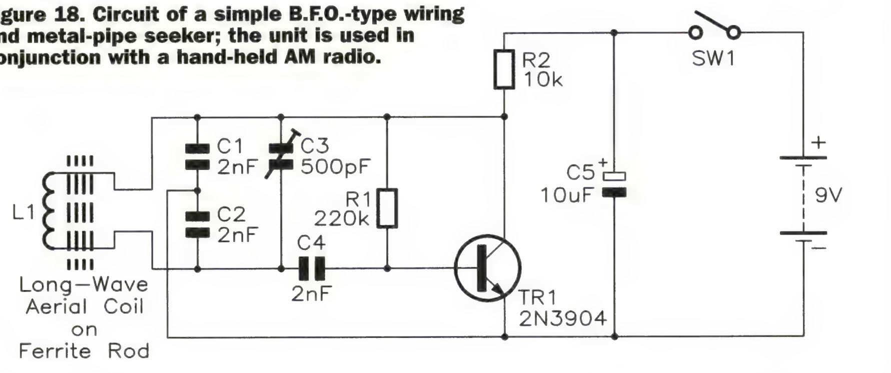

Figure 18. Circuit of a simple B.F.O.-type wiring and metal-pipe seeker; the unit is used in conjunction with a hand-held AM radio.

channelled to accept new cable runs and must be repaired afterwards. Essential tools for these jobs include two 2·5in. bolster chisels, a lump hammer, and a good power drill.

Before starting your first rewire, buy or borrow at least two good DIY books on the subject, and study them carefully. One highly recommended book is the Collins *Wiring & Lighting* DIY Guide, available from Maplin (Order Code WT56L), which gives step-by-step instructions on most practical aspects of house wiring. When you are ready, plan your new wiring layout with great care, giving lots of thought to the positioning of new power sockets, light switches, and ceiling roses, etc. In many houses, most of the original switch and power-socket wiring and floor-to-floor feeder cabling, etc., is fed via metal conduit (tubing), and your rewiring task may be greatly simplified by re-using this conduit, as explained in some of your DIY books.

Figures 17 to 19 show some useful rewiring aids. The Figure 17 and 18 circuits can be used for tracing old wiring and conduit, and the Figure 19 circuit acts as a 'marker beacon' that can be used to indicate the loft or under-floor break-through positions of pilot holes drilled through ceilings when installing new feeder cable runs or when re-positioning ceiling roses, etc.

The Figure 17 wiring tracer works on the magnetic-field detection principle and is used to trace 'live' wiring that (ideally) is actually passing current to a load. The wiring is located by sweeping across its suspected path with an ordinary telephone pickup coil until its 50Hz magnetic field induces a signal in the pickup coil. This signal is amplified by op-amp IC1 and power-boosted by the Q1-Q2 (etc.) amplifier, to finally produce a distinct 'hum' sound in the magnetic earpiece.

The Figure 18 circuit acts as a simple beat-frequency oscillator (B.F.O.) metal detector that is used in conjunction with a hand-held AM (long-wave or medium-wave) radio, and can be used to locate heavy-duty wiring or metal plumbing. The circuit is simply that of an L-C oscillator, in which the inductance of L1 (and thus the frequency of oscillation) is influenced when L1 comes near most common types of metal. In use, the unit and the small radio are switched on and the radio is tuned until a low 'beat' note is heard from its speaker; this 'beat' note should change when the unit's 'search head' (L1) is placed near metal. Hidden wiring (etc.) can then be located and its path traced by sweeping across its suspected route with the search head.

Finally, the Figure 19 'marker beacon' circuit consists of a simple low-frequency '555' astable multivibrator that pulses the LED on and off at a slow rate; the LED should be soldered to the end of a fairly stiff length of 2-core flex, so that it can easily be passed through small drilled (pilot) holes, etc.

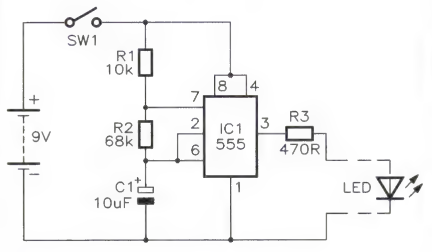

Figure 19. This 'marker beacon' circuit can be used to indicate the positions at which pilot holes break through into dark places.

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DEVELOPING APPLICATIONS AROUND THE PIC ARCHITECTURE

PART 2

Pickled Processors

by Stephen Waddington

Last month, we took a first look at the elements of a generic microprocessor. Here, Stephen Waddington talks through the basic characteristics of the PIC microprocessor

The PIC microprocessor family is available in three key flavours of increasing processing capability, as shown along the performance axis in Figure 1. These range from the low-end 20MHz PIC16C5X, typically with 12 I/O lines, a 12-bit instruction set and no interrupt resources, through to the 25MHz PC17CXX with up to 33 I/O lines, a 16-bit instruction set and up to 11 interrupts.

Figure 1 also shows another type of segmentation, in terms of local memory technology ranging from conventional ROM through to EPROM (Erasable Programmable Read Only Memory) and EEPROM (Electrically Erasable Programmable Read Only Memory). Pure ROM-based devices are the least versatile, since they can only be programmed once. By contrast, EEPROM based devices can be repeatedly programmed and re-programmed with ease.

The conventional way to develop a microprocessor-based system, is to determine the scope of the application and then select a microprocessor capable of handling the job. In many ways, we decided to turn this process on its head when we opted to focus purely on PIC-based microprocessors, rather than taking a wider outlook. The bad news for purists is that we're going to go one stage further. In order to get to grips with developing PIC systems from the ground up, this article will focus on a single member of the PIC family – the PIC16C84. Table 1 shows the key characteristics of this device, while Figure 2 shows a pin-out diagram.

CPU Features

- Only 35 instructions to learn
- All instructions are single cycle (400ns) except for program branches which are two cycle
- 10MHz clock
- 14-bit wide instructions
- 1,024 × 14 on-chip EEPROM program memory
- 36 × 8 general purpose registers (SRAM)
- 15 special function hardware registers
- 64 × 8 EEPROM data memory
- Eight level deep hardware stack
- Direct, indirect and relative addressing modes
- Multiple interrupt sources
- 1,000,000 ERASE/WRITE cycles
- Data retention greater than 40 years

Peripheral Features

- 13 I/O pins with individual direction control
- High current (25mA per pin) for direct LED drive
- 8-bit real time clock/counter with 8-bit programmable pre-scaler

Microprocessor Features

- Power-On Reset
- Power-up Timer
- Oscillator Start-up Timer
- Self clocked Watchdog Timer (WDT)
- Security EEPROM fuse for code protection
- Power saving sleep mode
- User selectable oscillator options
- Serial in-system programming capability

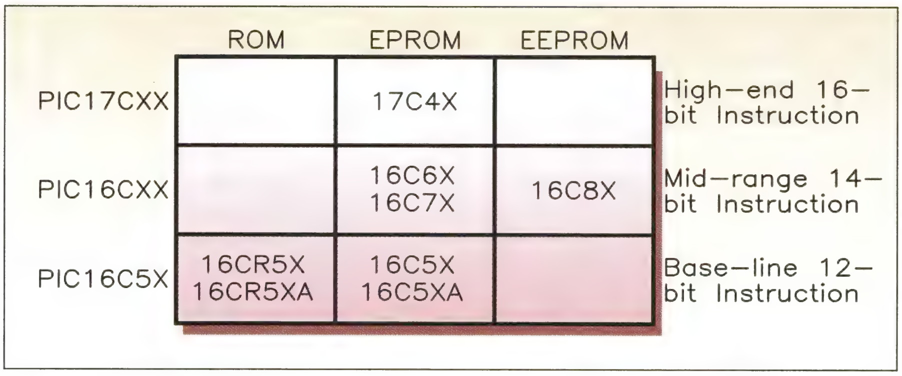
Electrical Characteristics

- Low power high speed CMOS technology
- Fully static design
- Wide operation voltage range (2·0 to 6·0V)
- Low power consumption: 2mA at 5V, 4MHz; 15μA typically at 2V

Table 1. Key characteristics of the PIC16C84.

However, it's not all bad news. The PIC16C84 is an excellent device to learn the basics of microprocessor and PIC development. It uses the standard PIC instruction set of 33 instructions, with two additions to address registers which are unique to the device. This means that once you've got to grips with programming the PIC16C84, you'll be able to work with any of the other devices in the PIC family. Perhaps even more attractive is the fact that it has 1K of local EEPROM. This makes it an ideal device to learn techniques on, since it can literally be programmed and re-programmed within 20 seconds. Figure 3 shows a block diagram of the PIC16C84.

For performance details of other members of the PIC family in comparison to the PIC16C84, check the Microchip Databook – see further reading at the end of this article. In later parts of this series, we will take a look in greater detail at other members of the PIC family.



	ROM	EPROM	EEPROM	
PIC17CXX		17C4X		High–end 16–bit Instruction
PIC16CXX		16C6X 16C7X	16C8X	Mid–range 14–bit Instruction
PIC16C5X	16CR5X 16CR5XA	16C5X 16C5XA		Base–line 12–bit Instruction

Figure 1. PIC 16/17 microcontroller families.

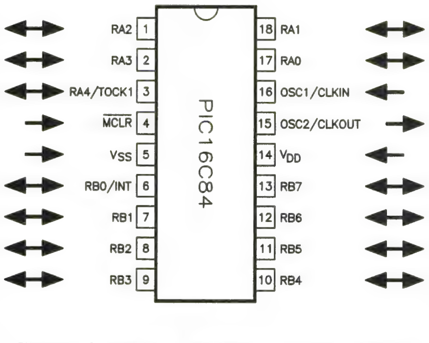


Figure 2. Pin-out diagram for PIC16C84.

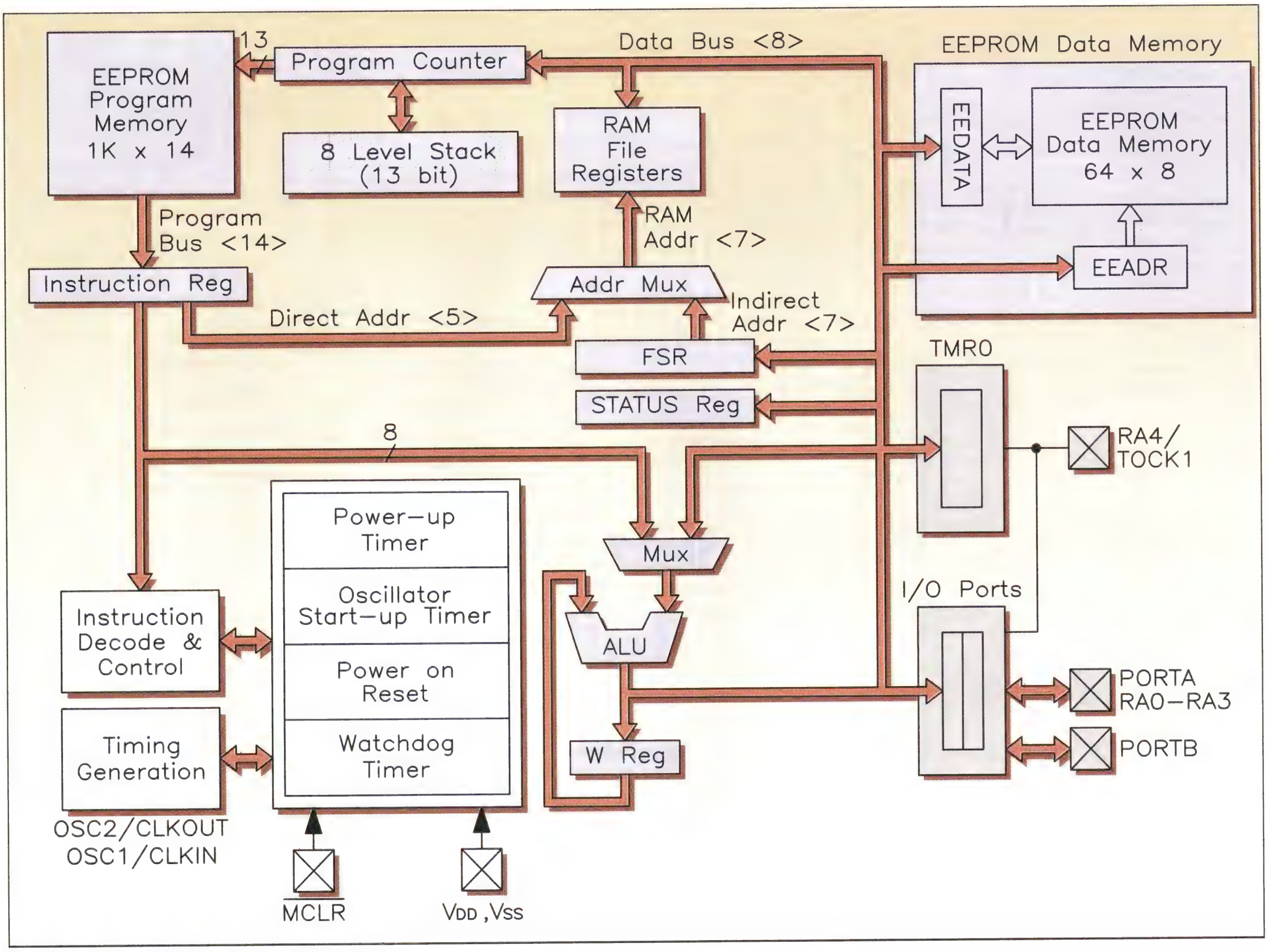
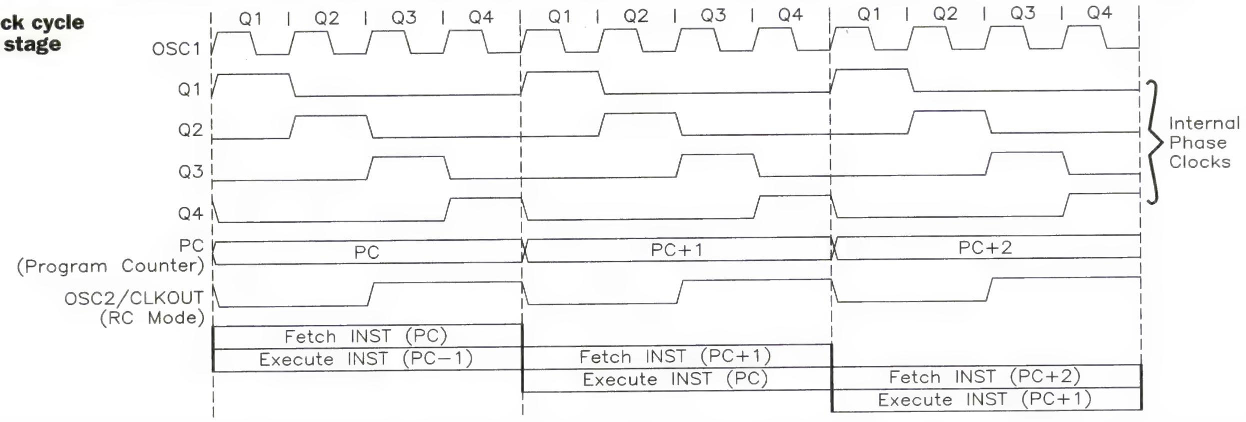


Figure 3. Block diagram of PIC16C84.

Figure 4. Clock cycle showing two stage pipeline.



Architectural Overview

The PIC16C84 is equipped with special features such as an internal clock, sleep function, and software watchdog to reduce external components and thus cost, while enhancing system reliability and power consumption. There are four oscillator options which can be optimised by the designer for cost or power savings. The power down or SLEEP mode enables the microprocessor to be shut down when not in use, providing power savings. The user can wake up the chip from SLEEP using external interrupts or via a reset function. Meanwhile, a watchdog timer with its own on-chip RC oscillator provides protection against software malfunction.

The PIC family is based on the Harvard architecture, which means programme and data are held in separate memories. This improves the performance of the device over the Von Neuman approach, where memory is shared. It also means that the instruction length or op-code is not tied to the length of the data word. Op-codes can be greater than the 8-bit data word because they occupy their own memory.

Clock/Instruction Cycle

In the PIC16C84, all op-codes are 14-bit wide. On-chip, 1K × 14-bit is reserved for program memory. A 14-bit wide program memory means that all instructions can be fetched in a single cycle. A two stage pipeline, as shown in Figure 4, is used to overlap the fetch, decode and execute cycle. This means that all instructions execute with a single clock cycle, with the exception of program jumps or branches.

The PIC16C84 can directly or indirectly address its 48 register files or data memory. All special function registers including the program counter are mapped in the data memory. The instruction set is fairly orthogonal, which makes it possible to carry out any operation on any register using any addressing mode. This symmetrical nature and lack of special optimal situations make programming with the PIC16C84 simplistic, yet efficient.

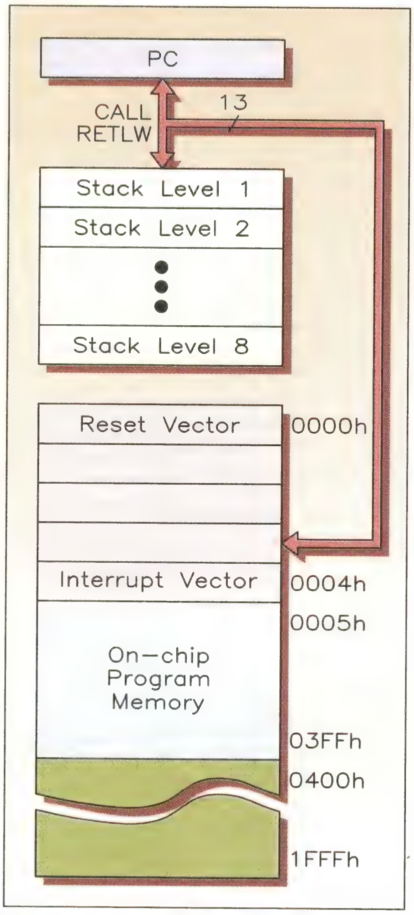


Figure 5. Program memory map and stack.

The clock input is internally divided by four to generate four non-overlapping quadrature clocks, namely Q1, Q2, Q3 and Q4, as shown in Figure 4. Internally, the program counter is incremented every Q1. An instruction is fetched from the program memory and latched into the instruction register in Q4.

An Instruction Cycle consists of Q1, Q2, Q3 and Q4 cycles. The Instruction fetch and execute cycles are pipelined such that a fetch takes one instruction cycle. However, due to the pipelining, each instruction effectively executes in one cycle. If an instruction causes the program counter to change, such as GOTO or JUMP, then two cycles are required to complete the instruction. A fetch cycle begins with the program counter (PC) incrementing in Q1. The fetched instruction is latched into the Instruction Register (IR) which is decoded and executed during Q2, Q3 and Q4. Data memory is read during Q2 (operand read) and written during Q4 (destination write).

Memory Organisation

The PIC16C84 has a 13-bit wide program counter, capable of addressing an 8K × 14-bit program memory space, as shown in Figure 5. Only the first 1K × 14-bit (0000h to 03FFh)* are physically implemented. Accessing a location above 03FFh will cause a wraparound within the first 1K × 14-bit space. The reset vector is at 0000h and the interrupt vector is at 0004h.

* xxxxh refers to a memory address in hexadecimal.

The EEPROM program memory of the PIC16C84 is rated for limited erase/write cycles. To program the program memory, the device must be put into a special mode by raising MCLR pin to high voltage. Also, V_{DD} must be 4·5 to 5·5V during programming. While this feature means the PIC16C84 is not suitable for applications where program memory is updated in the user application frequently, it does make it ideal for the design development.

Program Counter

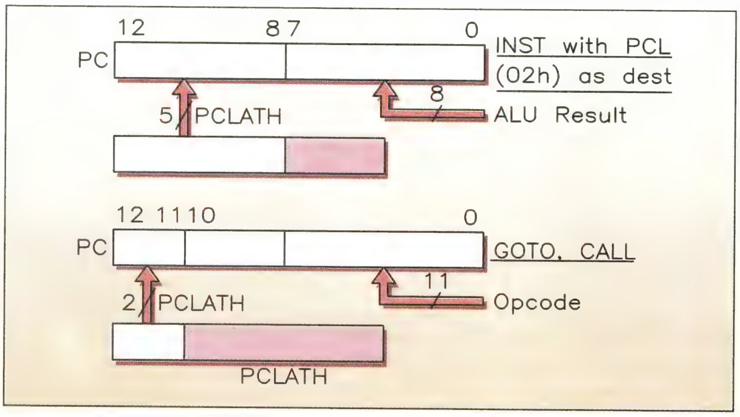
The program memory can be programmed serially using two data/clock pins, which makes in-system programming possible. This enables the designer to customise the system during final testing or upgrade a system in location.

The program counter (PC) is shown in Figure 6. The program counter low byte (PCL) is a readable and writable register. The high byte of the program counter (PCH) is not directly addressable or writable. However, it can be written through the PCLATH register (0Ah) when the PC is loaded with a new value during a CALL, GOTO or write to PCL.

Stack

The PIC16C84 has an 8 × 13-bit wide hardware stack. The stack space is not part of either program or data space and the stack pointer is not readable or writable. The value of the program counter is placed on the stack when a CALL instruction is executed or an interrupt is acknowledged. The stack is cleared in the event of a RETURN, RETLW, or RETFIE instruction execution.

Figure 6. Program counter organisation.



Registers

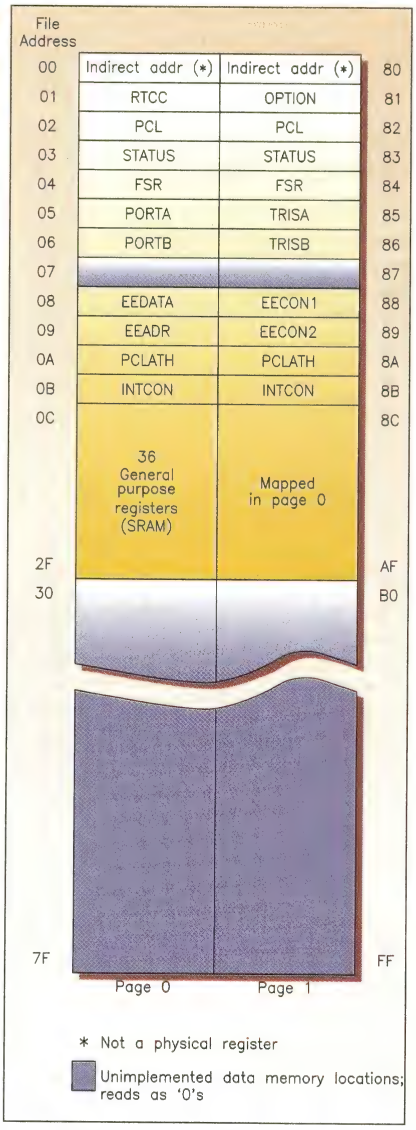
The register file is organised as a 128 × 8-bit block, as shown in Figure 7. It is accessed either directly or indirectly through the file select register (FSR). It is also referred to as the data memory. There are several register file page select bits in the STATUS register allowing up to four pages. However, data memory extends only up to 2Fh. The first 12 locations are used to map special function registers. Locations 0Ch to 2Fh are general-purpose registers implemented as static RAM. Some special function registers are mapped in page 1. When in page 1, accessing locations 8Ch to AFh will enable access the RAM in page 0.

There are two possible ways to address the register file, either directly using a physical number to represent an address, or indirectly using the result of a mathematical operation or by referencing the contents of another register. In both modes, up to 512 register locations can be addressed:

Direct addressing mode

An effective 9-bit address is obtained by concatenating 7-bits of direct address from the op-code and two bits (RP1, RP0) from the status register, as shown in Figure 8.

Figure 7. Register file map.



File Address	Page 0	Page 1	
00	Indirect addr (*)	Indirect addr (*)	80
01	RTCC	OPTION	81
02	PCL	PCL	82
03	STATUS	STATUS	83
04	FSR	FSR	84
05	PORTA	TRISA	85
06	PORTB	TRISB	86
07			87
08	EEDATA	EECON1	88
09	EEADR	EECON2	89
0A	PCLATH	PCLATH	8A
0B	INTCON	INTCON	8B
0C	36 General purpose registers (SRAM)	Mapped in page 0	8C
2F			AF
30			B0
7F			FF

* Not a physical register

▨ Unimplemented data memory locations; reads as '0's

ndirect addressing mode

ndirect addressing is achieved by using the ile address 00h (INDF). Any instruction sing INDF as file register actually accesses ata pointed to by the file select register (FSR). Reading INDF directly will produce 00h. Writing to indirectly results in no operation, lthough the status bits may be affected. An effective 9-bit address is obtained by concatenating the 8-bit FSR from the status egister, as shown in Figure 8.

Event	TO	PD
Power-up	1	1
WDT time-out	0	Unchanged
SLEEP instruction	1	0
CLR WDT instruction	1	1

Table 2. Events affecting $\overline{\text{TO}}$/$\overline{\text{PD}}$ status bits.

Reset Event	TO	PD
WDT wake-up from sleep	0	0
WDT time-out	0	1
MCLR wake-up from sleep	Unchanged	0
Power-up	1	1
MCLR reset during normal operation	Unchanged	U

Table 3. $\overline{\text{TO}}$/$\overline{\text{PD}}$ status after reset.

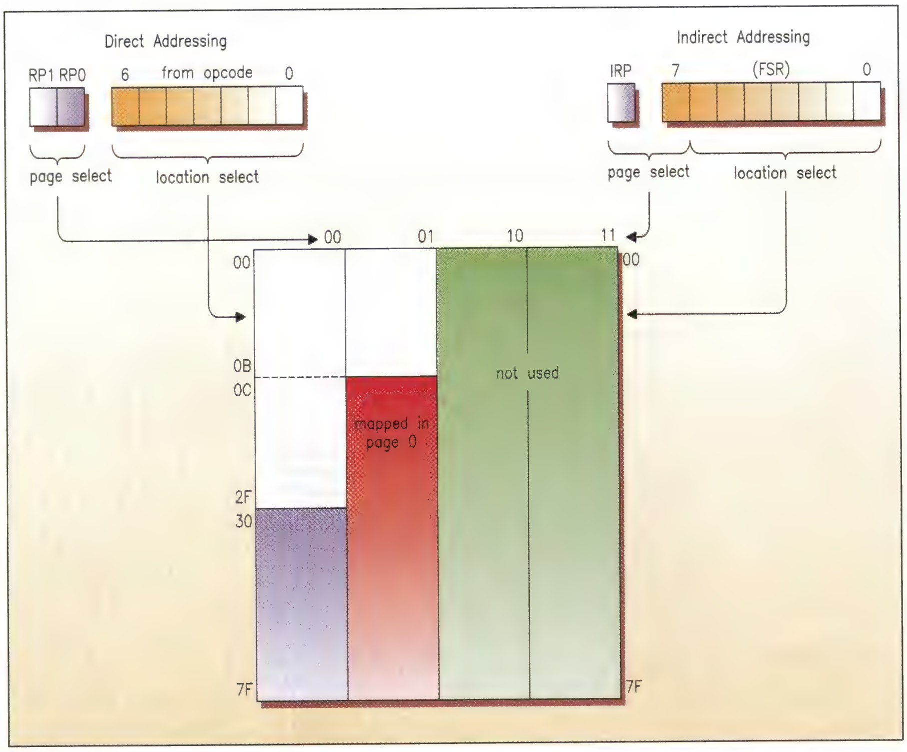
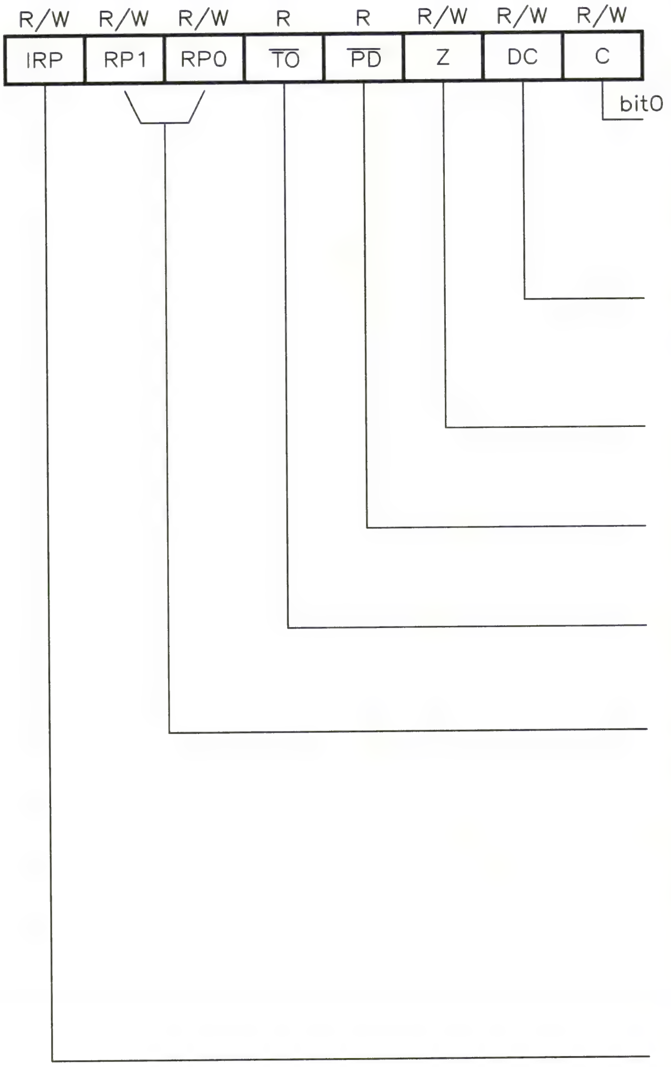


Figure 8. Direct and indirect addressing.



ADDRESS: 03h
RESET CONDITION: 000??XXX

CARRY/$\overline{\text{BORROW}}$ BIT:
For ADDWF, SUBWF, ADDLW and SUBLW instructions, this bit is set if there is a carry out from the most significant bit of the resultant. Note that a subtraction is executed by adding the two's complement of the second operand. For rotate (RRF, RLF) instructions, this bit is loaded with either the high or low order bit of the source register.

DIGIT CARRY/$\overline{\text{BORROW}}$ BIT:
For ADDWF, SUBWF, ADDLW and SUBLW instructions, this bit is set if there is a carry out from the 4th low order bit of the resultant.

ZERO BIT:
Set if the result of an arithmetic or logic operation is zero. Reset otherwise. Additionally, MOVF instruction will affect the Z bit.

POWER DOWN BIT:
Set to "1" during power up or by a CLRWDT command. This bit is cleared to "0" by a SLEEP instruction.

TIME-OUT BIT:
Set to "1" during power up and by the CLRWDT and SLEEP command. This bit is cleared to "0" by a watchdog timer time out.

REGISTER PAGE SELECT BITS FOR DIRECT ADDRESSING:
RP1,0 :
00 : page 0 (00h-7Fh)
01 : page 1 (80h-FFh)
10 : page 2 (100h-17Fh)
11 : page 3 (180h-1FFh)

Each page is 128 bytes.
Only RP0 is useful in PIC16C84. Bit RP1 can be used as a general purpose read/write bit. However, this may affect upward compatibility with future products.

REGISTER PAGE SELECT BITS FOR INDIRECT ADDRESSING:
IRP0 :
0 : page 0,1 (00h-FFh)
1 : page 2,3 (100h-1FFh)

This bit is effectively not used in the PIC16C84.

Figure 9. Status register.

Status Register

The STATUS register shown in Figure 9 contains the arithmetic status of the ALU, the RESET status, and the page preselect bits for data memory. Like any other register, the STATUS register can be the destination for any instruction. However, the status bits are set following the write operation (Q4). The and bits are not writable, and therefore, the result of an instruction with the STATUS register as its destination may be different than necessarily intended. For example, the command, CLRF STATUS will clear all bits except and and then set the z bit, leaving the STATUS register as 000XX100 – where X represents a bit unchanged. Tables 2 and 3 show how the and status bits change following a set or reset.

Microchip recommend that only BCF, BSF and MOVWF instructions are used to alter the STATUS registers, because these instructions do not affect any status bit.

Carry/Borrow Bits

The carry bit is a carry out in addition operations such as ADDWF and ADDLW, and a borrow out in subtract operations such as SUBWF and SUBLW. The digit carry operates in the same way as the carry bit. n this case, however, it is a borrow in subtract operations.

Arithmetic Logic Unit

The Arithmetic Logic Unit (ALU) is 8-bits wide and capable of addition, subtraction, shift and logical operations. Arithmetic operations are generally two's complement in nature. In two-operand instructions, typically, one operand is the working register (W register) or the accumulator. The other operand is a file register or an immediate constant. In single operand instructions, the operand is either the W register or a file register.

The W register is an 8-bit working register or accumulator used for ALU operations. It is not in the data memory.

Interrupts

The PIC16C84 has four sources of interrupt:

- External interrupt from RB0/INT pin.
- TMR0 timer/counter overflow interrupt.
- End of data EEPROM write.
- Interrupt on change on RB.

The interrupt control register (INTCON, addr0Bh), shown in Figure 10, records individual interrupt requests in flag bits. It also has individual local and global interrupt enable bits. A global interrupt enable (GIE) bit enables – if set – all unmasked interrupts or disables – if cleared – all interrupts. Individual interrupts can be disabled through their corresponding enable bits in the INTCON register. GIE is cleared on reset.

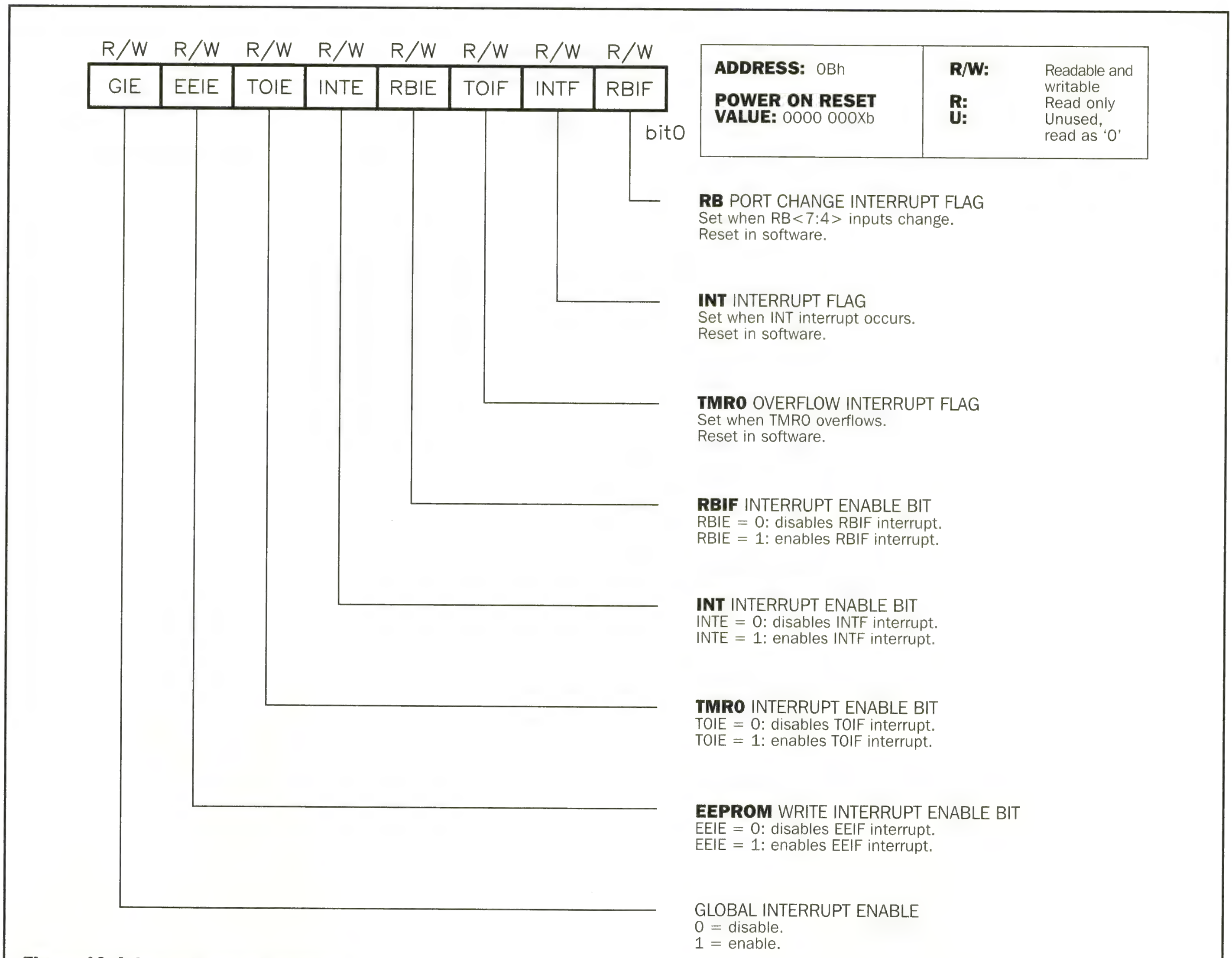
When an interrupt is responded to, the GIE is cleared to disable any further interrupt, the return address is pushed into the stack and the PC is loaded with 0004h. Once in the interrupt service routine, the source(s) of the interrupt can be determined by polling the interrupt flag bits. The interrupt flagbit(s) must be cleared in software before enabling interrupts to avoid recursive interrupts.

Next month, we'll focus on some of the special features and I/O capabilities of the PIC16C84. In Part 4 of the series, we will start building code for the PIC16C84, and begin to look at application development.

Further Reading

Data sheets containing further details of each of the PIC family are available from Maplin. Refer to the catalogue for details of individual devices.

Check the T.A.K. DesignS home page http://www.takdesign.demon.co.uk\ for FAQ's and PIC links.



ADDRESS: 0Bh	**R/W:**	Readable and writable
POWER ON RESET VALUE: 0000 000Xb	**R:**	Read only
	U:	Unused, read as '0'

RB PORT CHANGE INTERRUPT FLAG
Set when RB<7:4> inputs change.
Reset in software.

INT INTERRUPT FLAG
Set when INT interrupt occurs.
Reset in software.

TMRO OVERFLOW INTERRUPT FLAG
Set when TMRO overflows.
Reset in software.

RBIF INTERRUPT ENABLE BIT
RBIE = 0: disables RBIF interrupt.
RBIE = 1: enables RBIF interrupt.

INT INTERRUPT ENABLE BIT
INTE = 0: disables INTF interrupt.
INTE = 1: enables INTF interrupt.

TMRO INTERRUPT ENABLE BIT
TOIE = 0: disables TOIF interrupt.
TOIE = 1: enables TOIF interrupt.

EEPROM WRITE INTERRUPT ENABLE BIT
EEIE = 0: disables EEIF interrupt.
EEIE = 1: enables EEIF interrupt.

GLOBAL INTERRUPT ENABLE
0 = disable.
1 = enable.

Figure 10. Interrupt control register.

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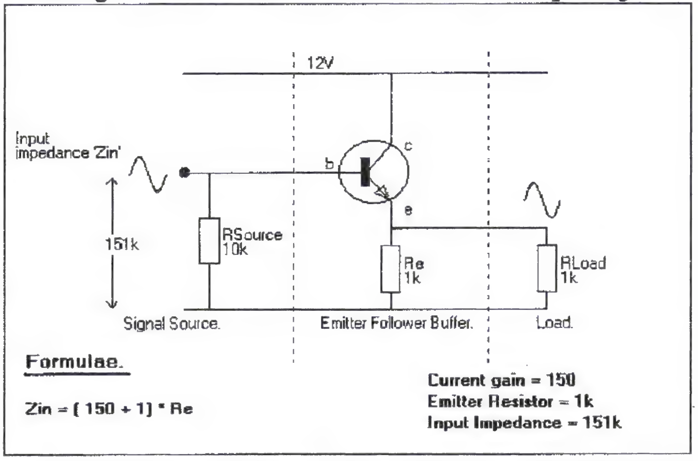

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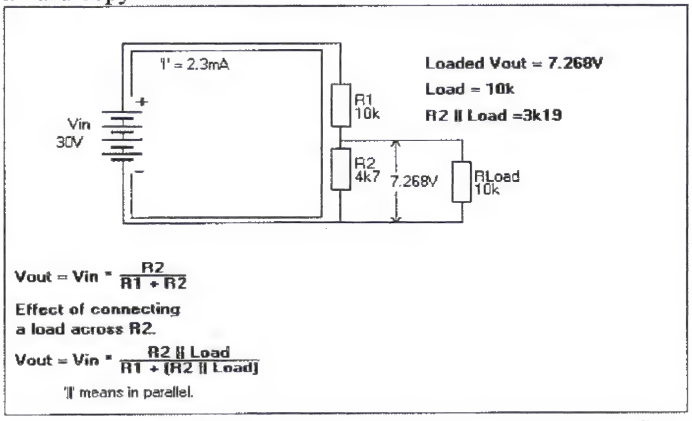

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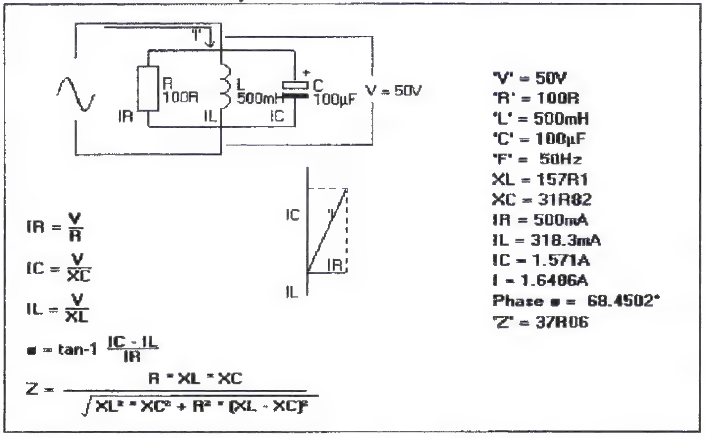

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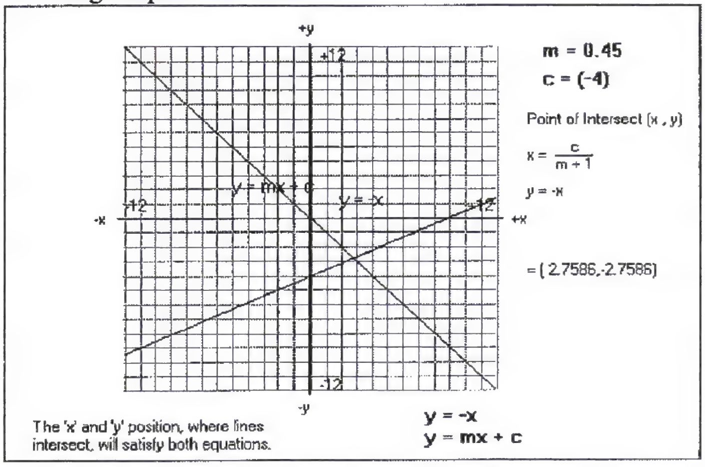
+y
-y
-x
+x
+12
-12
y = mx + c
y = -x
m = 0.45
c = (-4)
Point of Intersect (x , y)
x = c / m + 1
y = -x
= (2.7586,-2.7586)
The 'x' and 'y' position, where lines intersect, will satisfy both equations.
y = -x
y = mx + c

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Diary Dates

Every possible effort has been made to ensure that information presented here is correct prior to publication. To avoid disappointment due to late changes or amendments, please contact event organisations to confirm details.

October 1996

18 to 27 October. The Home PC Show, Autumn Ideal Home Show, International Motor Show and Connect '96, Birmingham NEC. Tel: 0121 767 4114.

20 October. Memorabilia '96. Europe's largest collectors for pop, film, SF culture, TV and comic collectables. Tel: (01462) 683965.

26 October. Computer Show, Concentrating on the 2X Spectrum and SAM Coupé. Quedgeby Village Hall, (outskirts of Gloucester on the B4008 Bristol Road, just of Junction 12 on the M5). Doors open to the public at 10.30am and close at 4.30pm. Tel: (01452) 412572.

28 October. Latest Kits and demonstrations, Stratford-upon-Avon & District Radio Society, Tiddington, Stratford-upon-Avon, Tel: (01789) 773286.

28 to 30 October. International Conference on Sizewell B – The First Cycle, IEE, London. Tel: (0171) 344 8432.

29 to 31 October. Electronics Commerce, Barbican Exhibition Centre, London. Tel: (0181) 332 0044.

30 October. Networld Interopt – Computer Networking & Interoperability, Earls Court, London. Tel: (0181) 849 6200.

November 1996

1 to 3 November. Acorn World Computer Show, Olympia, London. Tel: (01295) 788386.

6 to 9 November. Apple Expo, Olympia, London. Tel: (0171) 388 2430.

9 to 10 November. Radio Rally, Llandudno, North Wales. Tel: (01707) 659015.

11 November. System Approach to Manufacturing, IEE, Savoy Place, London. Tel: (0171) 344 5427.

11 November. Sounds of Yesteryear, Stratford-upon-Avon & District Radio Society, Tiddington, Stratford-upon-Avon. Tel: (01789) 773286.

18 November. System Approach to Manufacturing, IEE, Savoy Place, London. Tel: (0171) 344 5427.

25 November. Night on Air, Stratford-upon-Avon & District Radio Society, Tiddington, Stratford-upon-Avon, Tel: (01789) 773286.

26 November. Manufacture – Save Time, Save Money, IEE, Savoy Place, London. Tel: (0171) 344 5427.

December 1996

3 to 4 December. DSP UK – Digital Signal Processing Exhibition, Ramada Hotel, London. Tel: (0181) 547 3947.

3 to 5 December. International Online Information Exhibition, Ramada Hotel, London. Tel: (01865) 730275.

7 December. RSGB Annual Meeting, London. Tel: (01707) 659015.

8 December. SDX Cluster Support Group Eradio, Electronics & Computer Rally, Maryhill Community Centre Halls, Maryhill Road, Glasgow. Tel: (0141) 638 7670.

9 December. Quiz, Stratford-upon-Avon & District Radio Society, Tiddington, Stratford-upon-Avon, Tel: (01789) 773286.

25 December. Christmas Greetings on Air, Stratford-upon-Avon & District Radio Society, Tiddington, Stratford-upon-Avon, Tel: (01789) 773286.

January 1997

22 to 23 January. Sensors and Measurement Instrumentation, NEC, Birmingham. Tel: (01822) 614671.

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Please send details of events for inclusion in 'Diary Dates' to: News Editor, *Electronics and Beyond*, P.O. Box 777, Rayleigh, Essex SS6 8LU or e-mail to swaddington@cix.compulink.co.uk.

What's On?

New Exhibition Reveals All About Birth of the Universe

Everything that we know of, from the tiniest particles in our bodies to space and even time itself, exists because of the Big Bang – an unimaginably hot fireball explosion some fifteen billion years ago, from which the entire Universe was born. But what is the evidence for this astonishing theory? How can today's scientists make such a convincing claim about something that happened so long ago?

By bringing together all the key evidence and latest research, an exhibition which opened on September 5th at the Science Museum, exploring fundamental questions about the origins of the Universe. Called The Big Bang – Birth of the Universe, it is the final exhibition in the Museum's highly successful Science Box series about contemporary science, sponsored by Nuclear Electric.

Highlights of The Big Bang – Birth of the Universe exhibition include a video wall featuring computer simulation of a ride back to the beginning of time, an image of deep space taken through the Hubble telescope, an interactive display which illustrates how 90% of the Universe is 'missing', and a stuffed pigeon!

A free leaflet accompanies the exhibition, containing details of some of the most compelling recent evidence for the Big Bang. Workshops, demonstrations, drama performances and trails are just some of the events that will help visitors understand the Big Bang and related subjects.

Entrance to The Big Bang – Birth of the Universe, open until 5 January 1997, is included within the Science Museum's standard admission price of £5.50 for adults and £2.90 for concessions. The Science Museum is open daily from 10.00 to 18.00hrs.

For further details, check: `http://www.nmsi.ac.uk`.

Contact: Science Museum, Tel: (0171) 938 8000.

Engineering Profession Must Make Up Lost Ground

The engineering profession must overcome decades of cultural complacency if it is to regain lost status and attract high-calibre recruits, said Engineering Council Chairman, Alan Rudge, speaking at the Council's annual conference in London on September 2nd.

Dr Rudge urged the profession, industry and government to work more closely together to change public perception of the profession and enable it to effectively take the initiative on issues of national debate.

"We must find ways of pooling the efforts of the whole engineering community in order to create a more credible and productive dialogue with government", said Dr Rudge, adding that the established partnership between the Engineering Council and the professional Institutions should now include closer links with industry.

"The profession needs to gain a deeper understanding of industry and this calls for a more effective ongoing dialogue than we have achieved so far", he said.

Praising the government's Action for Engineering initiative, Dr Rudge announced that he would be discussing with Ian Taylor, the Minister for Science and Technology, how the work started by the initiative could be developed and its recommendations put into action.

Closer links between the profession and the government were also anticipated in the form of a Memorandum of Understanding between the Council and the DTI, which is currently being drafted. This, said Dr Rudge, would establish a clearer mutual recognition of what the government expects from the profession, and vice-versa.

The Conference, which addressed the key issues affecting the engineering profession and the challenges that lie ahead, is the first since the Engineering Council was restructured and relaunched as the voice of a unified profession in January this year. It also serves as a vehicle for a pre-launch event to the Year of Engineering Success (YES) – a major industry, profession and government-backed campaign aimed at raising public awareness of engineering achievement and highlighting the role of engineers in society.

Contact: Engineering Council, Tel: (0171) 240 7891.

Sega Opens Virtual Theme Park

Sega and Trocadero have teamed to open Europe's first interactive theme park in Piccadilly, London. Segaworld combines virtual reality and advanced computer graphics to create interactive entertainment instead of the movement on which traditional theme park rides rely. Sega already operates two such parks in Tokyo, and plans to open other ones in Sydney and elsewhere.

Occupying 110,000ft.^{2}, spanning four buildings of the original Trocadero building and three adjacent buildings and seven floors, Segaworld will have a capacity of about 3,000 visitors. It will provide six main high-tech interactive ride attractions. Exclusive to Sega and on the cutting edge of technology, the rides are the result of over $1 billion worth of research and development.

Minutes after arriving in Piccadilly Circus, visitors to Segaworld will be welcomed to a totally new and incredible technological world. Transported by rocket escalator to the top of Segaworld, they will then work their way down the floors. Each floor will be uniquely themed, containing a different ride and a host of interactive experiences.

Visitors will not only travel to, for example, outer space but will become immersed in it, even looking down to see their clothes transform into space suits. During tests on Aqua Planet, the undersea ride, people actually held their breaths because they thought they were underwater.

But Segaworld's unique thrill will be when the visitor influences each ride at will and actively participates in it. With the human mind playing such an influential role, each visitor will have a totally unique experience and no two visits to the attraction will ever be the same.

In addition to the six main ride attractions, Segaworld will have six themed zones, from Sports Arena to The Carnival.

Segaworld will provide the blueprint for a roll-out to major European cities over the next few years. As with Segaworld, each indoor theme park will be themed and customised to harmonise with the culture and character of the country and with its immediate environment.

Admission Prices: Adults £12.00, Children £9.00, Groups of 15 or more – 10% discount.

For further details, check: **http://www2.segaworld.com/sega/html/home2.html**.

Contact: Segaworld, Tel: (0171) 734 2777.

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Sound and Vision
Specialist Electronics: Components
Computer: Accessories and Networking

TEAM LEADER
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Maplin House, 274-288 London Road,
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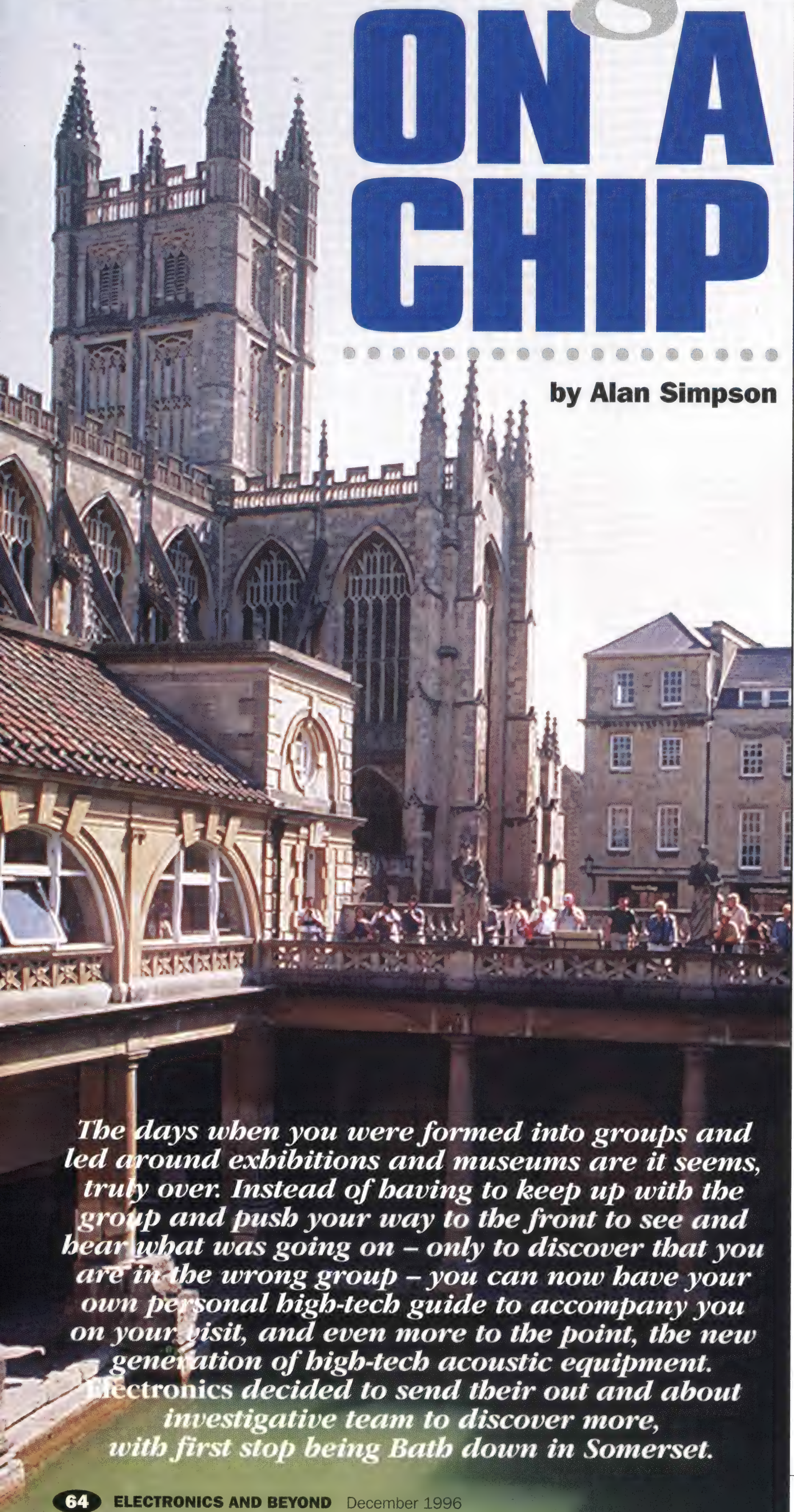
Please specify the post you are applying for.

Applications should contain sufficient information about qualifications, experience, personal qualities, etc. to enable us to short list candidates for interview.

Maplin Electronics PLC is an equal opportunities employer.

Heritage ON A CHIP

by Alan Simpson



The days when you were formed into groups and led around exhibitions and museums are it seems, truly over. Instead of having to keep up with the group and push your way to the front to see and hear what was going on – only to discover that you are in the wrong group – you can now have your own personal high-tech guide to accompany you on your visit, and even more to the point, the new generation of high-tech acoustic equipment. Electronics decided to send their out and about investigative team to discover more, with first stop being Bath down in Somerset.

INFORM is a user-friendly personal audio guide which incorporates the very latest in microchip technology and is up and running at Bath's historic Roman Baths Museum as well as at the Assembly Rooms and Museum of Costume. These museums are visited by more than 1 million people each year and this installation of the INFORM system is the largest recorded tour project in the world, with each visitor receiving a handset as they enter the museums.

The system has been created by Acoustiguide, probably the world's leading record tour company, but certainly their most ambitious to date. Following the system's successful introduction to the Louvre in Paris, where the units can be hired at the entrance to all three major galleries (though what the Mona Lisa makes of it all is not known), The National Gallery of Art, Washington and at the Tate Gallery in London are also users.

See All and Hear All

Complementing the conventional guided tours, the system consists of a hand unit resembling an early generation mobile phone. The 1,300 units on site provide visitors with random access to information relating to the museum displays, allowing them to tailor their visits to individual tastes and interests. Rather than following a predetermined route through the museum, the system allows the visitor to simply key-in the relevant number, press the 'play' button and listen to an informative description of any chosen item.

Language is no barrier: more than half the visitors to the Bath museums are from overseas, so the commentaries are available in French, German, Spanish, Italian and Japanese. In addition, single earpieces adapted for visitors with impaired hearing are available. INFORM was developed specifically for use in galleries, museums and visitor attraction centres, with the unit holding considerably more information than a cassette. A further advantage is that the robust unit has no moving parts and as it can be accessed randomly, it is particularly suitable for large sites and collections.

The Tour Guide at a Touch of a Button

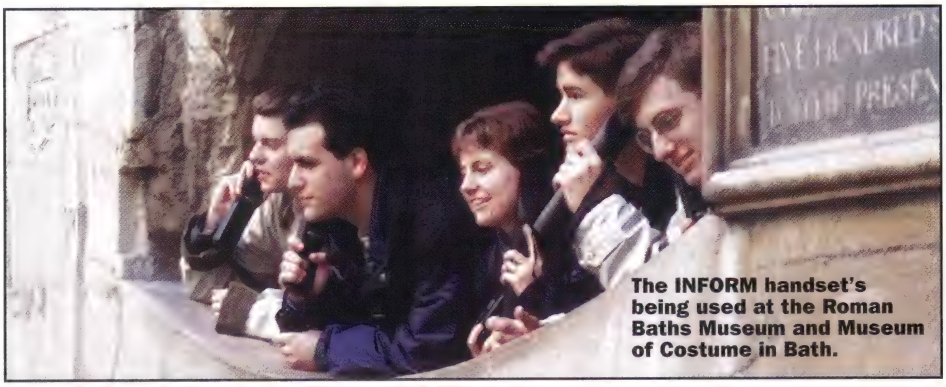
In terms of controls, the handset is simplicity itself. Controls include a backlit LCD display, an easy to read keypad, volume control, rewind/fast forward facility, and a pause/play button. System benefits include the ability to change the commentaries in a matter of minutes so that alterations to a gallery can be easily reflected in the audio microchip. For example, if an exhibit is removed, the tour information on the wand can be adjusted so that visitors won't wander the galleries looking for the missing item.

Flexibility is a key factor, as is the ability of museum staff to download the hand units – usually while re-charging the unit's battery is taking place – accessing such information as the most popular commentaries or the frequency that a particular item is visited. Also, such matters as how long the visitor has taken to tour the site or what sections have been skipped – invaluable data for administrators. In winter and off-peak times, the commentary capsule can be lengthened. Statistical information can be assembled in single or multiple samples.

Rather than follow a pre-determined route through the museum, each display or section of the building has its own number. Visitors simply key in the relevant number, press the 'play' button and listen to a commentary about any chosen item. Unlike the Louvre, where the numbers attached to each object are about the size of a raffle ticket, those at Bath are clearly visible. This, of course, allows low-scale lighting to be used where appropriate and avoids the imposition of small, difficult to read labels. The labels at Bath have been designed and placed in the most conspicuous position possible, and are repeated several times around a scene or item. Positioning is particularly important in the case of children or colour blind visitors.

Acoustiguide allows museum authorities or even the artist, to speak directly to visitors at the very moment they are looking and seeing the item. However, Bath and the Louvre are not the only sites equipped with the Acoustiguide system. They have spread to the Shanghai Museum in China and the Natural Science Museum in Taiwan. Closer to home, they have been installed in Canterbury Cathedral and the Heathrow Airport Visitors Centre.

At Bath, visitors to the Roman Baths can listen to a lively narration recorded by actors bringing to life the 'caldarium' and 'frigidarium' – Roman equivalents of the Turkish bath and cold plunge. Dramatised scenes conjure up daily life at the baths in Roman times: soldiers arguing in Latin, servants scurrying about preparing their master for his daily dip and, at the nearby sacred spring, A Roman matron cursing a thief for stealing her favourite bronze pot. INFORM also highlights key exhibits such as the life-size gilded bronze head of the goddess Sulis Minerva, discovered in 1727 by workmen digging in a nearby street.


The INFORM handset's being used at the Roman Baths Museum and Museum of Costume in Bath.

Information System Makes a Splash

Increasingly, the Bath museum is incorporating technology. While touch button screens are not as yet featured, terminals do keep a close security and safety tab on what is happening within the site. Meanwhile, a virtual reality display recreates the Roman Bath complex as it was nearly 2,000 years ago. The computer graphics, incidentally, were designed by the aptly named Splash! Software Company, who worked from original drawings and documents.

Also, a degree of Roman technology has been expanded to embrace that of heat exchange. Re-using original Victorian pipes, the heat from the bubbling spring water below provides all but 5% of the energy requirements of the Museum. However, during protracted cold spells, thermostatic controls switch on conventional gas-fired boilers. (Presumably, the Romans just threw on extra towels). Not surprisingly, Bath is one of the top Local Authorities' six buildings in the country in terms of energy conservation.

The Roman Baths Museum is the most visited museum outside London, with more than 900,000 visitors every year. In Europe, Bath shares the accolade with Florence as being designated by UNESCO as World Heritage Cities. Built around the only hot springs in the UK, the museum encompasses the remains of the Temple of Sulis Minerva, goddess of wisdom and healing, and the massive bathing complex which the Romans built next to the Temple and the spring.

Rain fell at 14·5°C, some 10,000 years ago on the nearby Mendip Hills. Driven down through carboniferous limestone cave systems by pressure from the high water table, water wells up from a depth of 3km at the rate of more than 1,100,000 litres per day. For those of a geological persuasion, the water penetrates overlying strata of impermeable Lias clay through fissures and a fault, to rise at three points in Bath. There are some 43 minerals in the water. Calcium and sulphate are the main dissolved metals, except for iron, which gives the characteristic iron staining around the baths and contributes to the water's distinctive flavour. The mineral content is 2·18g/litre.

More medical notes. In medieval times, a cure for conditions such as paralysis, colic, palsy and gout was sought from bathing in spa water. The fashion for drinking spa water arose from new medical ideas in the later 17th century. The water, it appears, was taken in the morning. For most visitors, a pint or two was sufficient, but as much as a gallon a day could be prescribed. The Roman Baths and Temple and the Grand Pump Room built above them in 1795, is a scheduled ancient monument.

All this, of course, is a far cry from the world of the microchip-driven INFORM system. But as the museum itself admits, visitors now comment on the quality of the exhibits and their enjoyment of the museum rather than the technical wizardry of the audio guides. Just what those bathing Romans would have made of the Acoustiguide is a matter for conjecture. However, for *Electronics* readers, there is a great chance to sample the system for themselves. We have no less than 10 family tickets to be won, valued at £17.60 per set. These will get you in the Roman Baths and the Museum of Costume.

So, grab your toga and get ready to pick up your Acoustiguide issued free with the ticket. And don't worry about dropping your handsets into the water. The units come fully equipped with a length of cord – to go around the neck.

Acoustiguide's new INFORM system, launched at the Roman Baths Museum, the Assembly Rooms and the Museum of Costume, Bath, on 15th November 1995.

Bath Museum

Entrance charge for the Roman Baths Museum is £5.60 for adults and £3.30 for children. Museum of Costume admission is £3.50 for adults and £2.20 children. Combined tickets are £7.50 for adults, £4.00 for children and £17.60 for families. Open daily round the year.
Tel: (01225) 477000/477785.

BATH MUSEUM

Exclusive Competition

Sample the new Acoustiguide's INFORM in Bath for yourself with another exclusive competition from* Electronics and Beyond*. You could win one of ten Family Tickets (worth £17.60 per set) to* BATH MUSEUM*. Simply answer the competition questions and you could be a lucky winner!

How to enter

All you have to do to enter, is complete the coupon, correctly answering the four questions, or send your answers on a postcard of back of a sealed-down envelope. Don't delay – all entries must be received by 25th November 1996. Send your entry, remembering to include your name and address, and if possible, your day-time telepone number, to the address printed on the coupon.

Please note that employees of Maplin Electronics, associated companies and family members are not eligible to enter. In addition, multiple entries will be disqualified. The prizes will be awarded to the first all-correct entries drawn. The editor's decision will be final. Prizes are not exchangeable for cash. Any related travel costs will not be met by the publication or the competition sponsors.

BATH MUSEUM COMPETITION

Answer all the questions below, ticking one box for each question.

1. Where are the Roman Baths situated?
☐ The Bath Spa complex.
☐ The British Museum.
☐ Under the Pier, Southend-on-Sea.

2. Who would you have expected to find taking to the waters in Roman Bath?
☐ Pamela Anderson.
☐ A Roman Legionnaire.
☐ A Club Med snorkel class.

3. Why would anyone take to the waters?
☐ To alleviate a water drought.
☐ To cure a health problem.
☐ To top up the goldfish bowl.

4. Following a plunge in the Roman Baths, what happened next?
☐ The Romans went to a local disco.
☐ The Romans went to a McDonalds.
☐ The Romans took a steam bath.

Name ______________________
Address ______________________
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______________ ***Postcode*** ______________
Daytime Telephone Number ______________

No purchase necessary.
Entries on a postcard, back of a sealed-down envelope or photocopies will be accepted.

ELECTRONICS and Beyond

Send your entry to
Bath Museum Competition,
The Editor, *Electronics and Beyond*,
P.O. Box 777, Rayleigh, Essex SS6 8LU.

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Computers

Build a quality 486 PC for under £200 inclusive! No special skills or knowledge required. Send SAE for details to: Richard Garland, 10 Barford House, London E3 5HP.

PSION Organiser LZ64 with PC lead/ software, spreadsheet, developer's kit, power supply, case and Digitron Datalogger SF12 with thermocouple adapter, PC lead, voltage probes, software. £450 ono. Contact: Paul (0116) 281 0248, evenings.

Various

Bench Test Equipment Levell RC oscillator type TG200M. 1Hz-10MHz! Output –60dBm to +10dBm. Ideal for professional audio equipment. Bargain £50. 50W amplifier, XLR balanced input. Outputs are 4-15Ω plus 100V, £30. Professional radio clock receiver in a 19in. rack. Type RC-060-C. Time/calender switch, plus LEDs for 'BST', '1pps', 'data' and 'valid'. Mains powered, £30. 8× audio distribution amplifiers housed in a 19in. 3U rack. Each of the eight amplifiers has one audio input and ten audio outputs. Every output is isolated and balanced. Ideal for theatres, etc. Professional broadcast quality, £75. All the above are plus P&P. Tel: (01603) 759339.

Gang of Eight EPROM Programmer. Still boxed, as new, £200. EasyPC PCB artwork design software with manuals, £50. Telequipment 20MHz dual-beam oscilloscope, £75. Tel: Leeds (0113) 279 7342.

New Ultrasonic Car Alarm Add-on. Badged as Nelson but made by Moss, 3·5mm stereo jack for 12V and active low, £8. Tel: (01803) 615510.

Oscilloscopes – Telequipment D61A 10MHz 6in. plus manual, £55. Heathkit Model 10-12U 5MHz 5in. plus manual, £18. Daystrom valve voltmeter, model-7A/UK input resistance 11MΩ plus manual, £10. Tel: (01959) 575764, daytime.

Photovoltaic Array. High quality laminated design, tempered self-cleaning glass. 49W@16·7V, dimensions 985mm × 445mm. Boxed, mint condition, £250 ono. Tel: (01427) 668317.

Wanted

Bernard Babani Books wanted for an 11-year old enthusiast. Will pay a good price. Tel: (01902) 731906.

CA3019, SSM2044, μA726C, 1N458A, also information on diode/LED CL-1. Contact: Chris Crosskey, 40 Evelin Road, Abingdon, Oxon OX14 1JR. Tel: (01235) 534152.

Contacts with Musicians interested in testing electronic tuned percussion instrument (similar to MIDI xylophone). Write to: Ivan Roulson, 5 Lincoln Close, Feniton, Honiton, Devon EX14 0EQ.

Swop Service Manuals, Data Sheets, etc. Contact: Mark, 14 Stockwood Drive, Corby, Northants NN17 1JL.

Wanted for AKAI GX-625 open reel tape recorder, a handbook or copy plus a remote control unit, or information of both. Contact: Dr. R. C. Armstrong, 'Welland', Stafford Street, St. Georges, Telford, Shropshire TF2 9DT. Tel: (01952) 616410.

Placing an advertisement in this section of *Electronics and Beyond* is your chance to tell the readers of Britain's best magazine for electronics enthusiasts what you want to buy or sell, or tell them about your club's activities – Absolutely Free of Charge! We will publish as many advertisements as we have space for. We will print the first 30 words free, but thereafter the charge is 10p per word for each added advert per reader.

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Readers who have reasonable grounds to believe they have been misled as to the nature of an advertisement are advised to contact the Publisher and their local Trading Standards Office.

Club Corner

ARS (Aberdeen Amateur Radio Society) meets on Friday evenings in the RC Hall, 70 Cairngorm Crescent, Kincorth. For details contact: Martin, (CM0JCN), Tel (01569) 731177.

The British Amateur Electronics Club (founded in 1966), for all interested in electronics. Four newsletters a year, help for members and more! UK subscription £8 a year (Junior members £4, overseas members £13.50). For further details send S.A.E. to: The Secretary, Mr. J. F. Davies, 70 Ash Road, Cuddington, Northwich, Cheshire CW8 2PB.

Bury St. Edmunds Amateur Radio Society. Meetings held at Culford School, 7.30pm for 8.00pm on the third Tuesday of each month, unless otherwise stated. Further details from Kevin Waterson, (G1GVI), 20 Cadogan Road, Bury St. Edmunds, Suffolk IP33 3QJ. Tel: (01284) 764804.

Crystal Palace and District Radio Society meets on the third Saturday of each month at All Saints Church Parish Rooms, Beulah Hill, London SE19. Details from Wilf Taylor, (G3DSC), Tel: (0181) 699 5732.

Derby and District Amateur Radio Society meets every Wednesday at 7.30pm, at 119 Green Lane, Derby. Further details from: Richard Buckby, (G3VGW), 20 Eden Bank, Ambergate DE56 2GG. Tel: (01773) 852475.

Electronic Organ Constructor's Society. Details of programme magazine and membership from: Don Bray (Hon. Sec.), 34 Etherton Way, Seaford, Sussex BN25 3QB. Tel: (01323) 894909.

E.U.G. User group for all 8-bit Acorn Micros, since 1991. Still going strong. Programming, news, information, sales. Contact: E.U.G., 25 Bertie Road, Southsea, Hants. PO4 8JX. Tel: (01705) 781168.

The Lincoln Short Wave Club meets every Wednesday night at the City Engineers' Club, Waterside South, Lincoln at 8pm. All welcome. For further details contact Pam, (G4STO) (Secretary). Tel: (01427) 788356.

Model Railway Enthusiast? How about joining 'MERG', the Model Electronic Railway Group. For more details contact: Paul King (Honorary Secretary), 25 Fir Tree Way, Hassocks, West Sussex BN6 8BU.

Preston Amateur Radio Society meets every Thursday evening at The Lonsdale Sports and Social Club, Fulwood Hall Lane, Fulwood, (off Watling Street Road), Preston, Lancashire PR2 4DC. Tel: (01772) 794465. Secretary: Mr Eric Eastwood, (G1WCQ), 56 The Mede, Freckleton PR4 1JB, Tel: (01772) 686708.

Science At Your Fingertips. Want to meet friends interested in Science? Send an SAE to: Daniel Gee, S.A.Y.F., 37 South Road, Watchet, Somerset TA23 0HG, or Scott Mason, S.A.Y.F., 58 Park Avenue, Devonport, Plymouth PL1 4BP. `http://homepages.enterprise.net/icedragon/says.htm`.

SEEMUG (South East Essex Mac User Group), meet in Southend, every second Monday of each month. For details Tel: Michael Foy (01702) 468062, or e-mail to `mac@mikefoy.demon.co.uk`.

Southend and District Radio Society meets at the Druid Venture Scout Centre, Southend, Essex every Thursday at 8pm. For further details, contact: P.O. Box 88, Rayleigh, Essex SS6 8NZ.

Sudbury and District Radio Amateurs (SanDRA) meet in Gt. Cornard, Sudbury, Suffolk at 8.00pm. New members are very welcome. Refreshments are available. For details please contact Tony, (G8LTY), Tel: (01787) 313212 before 10.00pm.

TESUG (The European Satellite User Group) for all satellite TV enthusiasts! Totally independent. TESUG provides the most up-to-date news available (through its monthly 'Footprint' newsletter, and a teletext service on the pan-European 'Super Channel'). It also provides a wide variety of help and information. Contact: Eric N. Wiltsher, TESUG, P.O. Box 576 Orpington, Kent BR6 9WY.

Thanet Electronics Club. For school age Ham Radio and Electronics enthusiasts, enters its 16th Year. Meetings held every Monday evening from 7.30pm at The Quarterdeck, Zion Place, Margate, Kent. For further details contact: Dr. Ken L. Smith, (G3JIX), Tel: (01304) 812723

Wakefield and District Radio Society meet at 8.00pm on Tuesdays at the Community Centre, Prospect Road, Ossett, West Yorkshire. Contact Bob Firth, (G3WWF), (QTHR), Tel: (0113) 282 5519.

The (Wigan) Douglas Valley Amateur Radio Society meets on the first and third Thursdays of the month from 8.00pm at the Wigan Sea Cadet HQ, Training Ship Sceptre, Brookhouse Terrace, off Warrington Lane, Wigan. Contact: D. Snape, (G4GWG), Tel: (01942) 211397 (Wigan).

Winchester Amateur Radio Club meets on the third Friday of each month. For full programme contact: G4AXO, Tel: (01962) 860807.

Wirral Amateur Radio Society meets at the Ivy Farm, Arrowe Park Road, Birkenhead every Tuesday evening, and formally on the the first and third Wednesday of every month. Details: A. Seed, (G3FOO), 31 Withert Avenue, Bebington, Wirral L63 5NE.

Wirral and District Amateur Radio Society meets at the Irby Cricket Club, Irby, Wirral. Organises visits, DF hunts, demonstrations and junk sales. For further details, please contact: Paul Robinson, (G0JZP) on (0151) 648 5892.

BBS Corner

Apple Crackers. FirstClass Client BBS, mainly for AppleMac and PC users. Baud rate 2·4K-bit/s to 28·8K-bit/s, 8 data bits, no parity, 1 stop bit. Tel: (01268) 781318/780724.

Mactel Metro/Iconex. FirstClass Client BBS, AppleMac and PC users. E-mail address on Internet for registered users. Baud rate 2·4K-bit/s to 28·8K-bit/s, 8 data bits, no parity, 1 stop bit. Tel: (0181) 543 8017 (Metro) or (0115) 9455417 (Iconex).

Spider! Amiga BBS. The lighter alternative. Mainly Amiga and some PC files. Fidonet, Mercurynet and Mufonet. Online games. Speeds up to 19200. Tel: (01568) 613520.

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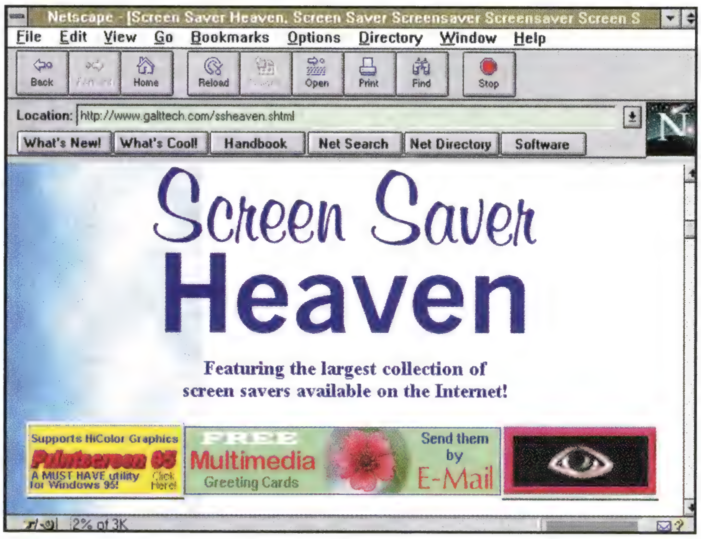
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Featuring the largest collection of screen savers available on the Internet!

Save Your Screen With Internet Search

If you're bored with Starship Simulation and Flying Windows, venture out onto the Web and download yourself a new screen saver. Organisations – both commercial and non-profit making, have been quick to follow Guinness, which last year launched a full animation screen saver with sound, based on its TV advertisement campaign.

If you try doing a search on Alta Vista at **`http://www.altavista.digital.com`** or one of the other Internet search engines for 'screen saver', you'll find more than 10,000 Web pages returned. Narrow the search to include 'download' and 'free' – after all, you don't want to spend any money – and you'll find around 900 Web pages returned. We've included some of best here:

◆ **`http://www.win-uk.net/~jmoore/jon/ssaver.htm`**. 'The Hedgehog's Bad Dream' is a screen saver with an environmental theme. It is a dynamic photo-montage, reflecting the current activities at the Newbury bypass and environmental demonstrations elsewhere around the country.

◆ **`http://ourworld.compuserve.com/homepages/silkmoth/6_downl.htm`**. A No Smoking image and Elephant wallpaper – a variation on Microsoft's Window's wallpaper – are available for download from UK software house, Silkmoth.

◆ **`http://www.beyondthewall.com/dlsave`**. US poster company, Beyond The Wall, offers a screen saver based on 24 full screen pop-art images shown in a movie sequence to Web browsers that complete its brief questionnaire.

◆ **`http://www.etch-a-sketch.com/etchpgs/etchss.html`**. Remember Etch A Sketch? A screen saver version of the famous Etch A Sketch frame, along with five colour-animated screen savers are available here.

◆ **`http://www.galttech.com/ssheaven.shtml`**. This is reckoned to be the most comprehensive repository of screen savers available on the Internet. It's not completely exhaustive – none of the sites listed here are included – but it is packed with cool material, ranging from cartoon animation to interactive fish tanks.

Internet Config

Users of Internet Config on the Apple Macintosh should be aware that version 1.3 is released and available at several shareware sites including **`ftp://ftp.tidbits.com/pub/tidbits/select/internet-config.hqx`**.

Internet Config is a freeware general-purpose Internet controlling system extension for the Mac which takes care of Internet-related topics and makes a doddle of handling multiple Internet programs on the one computer. Version 1.3 adds a few new tricks to its already impressive array.

If you're not using it, you should be.

Internet Growth Heading for Red Light

According to a new study from market research house, Yankelovich Partners, the Internet is at a critical juncture. The study, Yankelovich's second annual Cybercitizen Report, reckons Internet and online usage continued to grow at 50%, from May 1995 to May 1996, but the growth from May 1994 to May 1995 was 100%.

In fact, the study predicts that growth will slow to 20% unless there's widespread movement among businesses to give employees Internet access, or unless prices for the computer equipment necessary to get online fall dramatically.

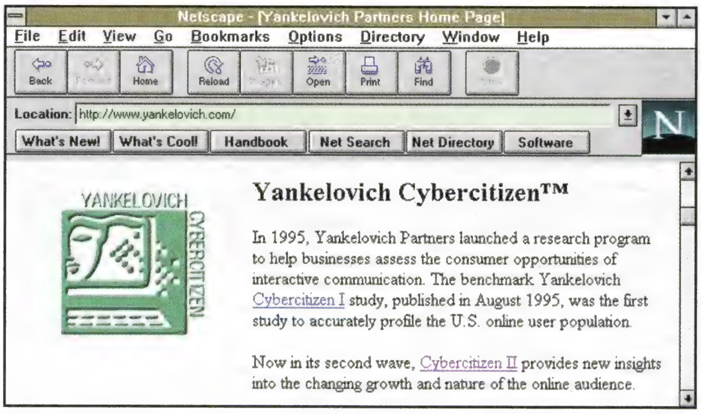
The study also reports that the average time online fell during the last 12 months from more than 16 hours a month to 12 hours a month.

"Slower growth and declining usage suggest marketers need to look beyond the faddish curiosity that has so far characterised online evolution. Marketers now need to identify compelling new reasons for people to log on and new ways of sustaining existing interests", Dr Walker Smith, Managing Partner, Yankelovich Partners told *Electronics and Beyond*.

"Consumers and marketers embraced cyberspace in 1995 without necessarily questioning why. The time has come for marketers to demonstrate a return can be made from online investments".

For further details, check: **`http://www.yankelovich.com`**.

Contact: Yankelovich Partners, Tel: (203) 845 8288.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CYBERCITIZEN

Yankelovich Cybercitizen™

In 1995, Yankelovich Partners launched a research program to help businesses assess the consumer opportunities of interactive communication. The benchmark Yankelovich Cybercitizen I study, published in August 1995, was the first study to accurately profile the U.S. online user population.

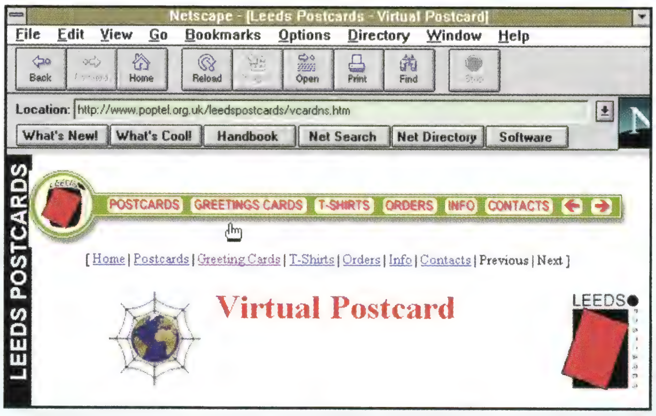
Now in its second wave, Cybercitizen II provides new insights into the changing growth and nature of the online audience.

Internet Intimacy

Whatever Internet fans claim about the Internet, it remains completely impersonal. Okay, so it might be possible to 'chat' online by exchanging short messages, or send a long document to a string of people at the push of a button, but Internet communication lacks the intimacy of a handwritten note or telephone call.

Leeds Postcards claim to have solved this problem – at least, in part. Using its site at **`http://www.poptel.org.uk/leedspostcards`**, you can now send a virtual postcard to anyone with an e-mail address. Enter their details, a brief message, select a postcard from one of 30 Leeds satirical postcards, and you're away.

Your recipient will receive an e-mail shortly afterwards, with details of a Web address where they can go and collect their card. As with all Leeds Postcard's material, the cards are witty, clever and well presented.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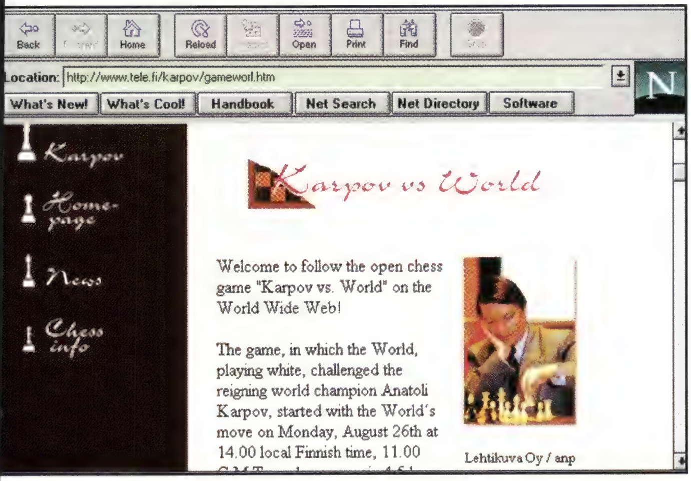

Welcome to follow the open chess game "Karpov vs. World" on the World Wide Web!

The game, in which the World, playing white, challenged the reigning world champion Anatoli Karpov, started with the World's move on Monday, August 26th at 14.00 local Finnish time, 11.00

Karpov Wins Online Chess Match

n an open chess game on the Internet, Russian grandmaster, natoly Karpov, defeated several hundred opponents in a game hat lasted 65 moves and four and a half hours. For each move, ontestants had seven minutes to indicate their response, and a omputer calculated the most frequently suggested response. Details of the game and forthcoming chess events can be found at: **ttp://www.tele.fi/karpov/gameworl.htm**.

Shareware Web Site Creation Tool

Everyone, it seems, is having a go at building Web sites, from advertising agencies to PC vendors and from Internet service providers to graphic designers – even freelance journalists are having a go. And there's no end of tools to help novices get started. All of the major design-based software houses created Web development tools, and even companies such as Novell and Microsoft have built utilities to convert word-processor documents into HTML code.

Now, the Thompson Partnership is getting in on the action. The UK software house has launched WebExpress, a shareware application available from its Web site at **http://www.ttp.co.uk** to enable users to create a Web site from scratch. Registration costs £58.

WebExpress is modelled on a word-processor. It allows text to be formatted and manipulated like any conventional word-processor, while graphics can be imported in GIF or JPEG formats into a text stream, either within the document or within a table cell.

WebExpress allows the user to configure background colours or images for your document and also alter the default colour for text and hypertext links.

There is nothing particularly unique or clever about WebExpress, except that it very easy to use, is low-cost, and can be downloaded from the Web. Its key limitation lies in the fact that the user is always limited by pre-defined options.

Contact: The Thompson Partnership, Tel: (01889) 564601.

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Bug off

If you're using Microsoft's latest version of its Web browser Internet Explorer – version 3 – (and there are well over a million people already using it), it's worth bearing in mind that there is a bug in the program. Normally, a bug in a program's no big deal, but this one is potentially so important that you should download the official Microsoft fix for it as soon as you can. Apparently the bug means that computer hackers can access a personal computer via the Internet. All they need to do is set up a Web site and wait for a personal computer user to access the pages of the site using the Web browser. While the browser is on the hacker's site the hacker can download the computer's data, and even erase all or part of the information on the computer.

Funnily enough, the bug was found only by sheer chance, when Microsoft asked Princeton University to examine the Web browser's ability to use Java applets. While doing the work the university found the bug and notified Microsoft. The bug fix also clears up a few other (less potentially serious) known bugs.

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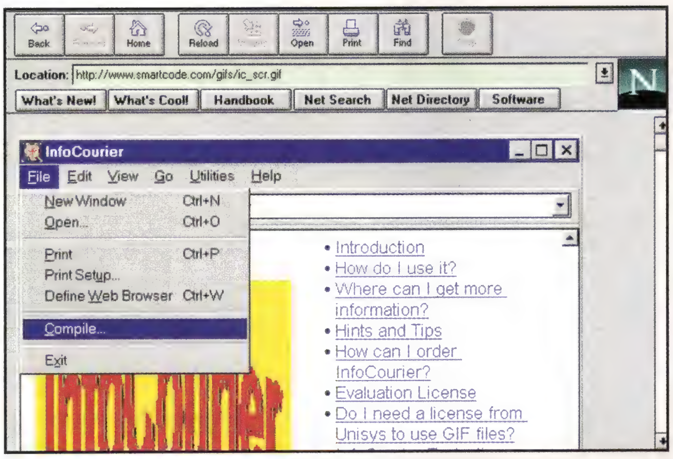
HTML Compiler

Oakley Data Services has launched an HTML compiler called InfoCourier for converting HTML files into executable code that can be viewed without using a Web browser. InfoCourier is available in Windows 3.1, '95 and NT flavours, priced around £120. An evaluation copy is available at **http://www.smartcode.com** or via FTP at **ftp://ftp.smartcode.com**.

Contact: Oakley Data Services, Tel: (01889) 565064.



NC-v-PC

Microsoft has finally admitted that the Network Computer (NC) concept, devised originally by Oracle, but now backed by most computer and software producers (in fact, just about all computer and software producers except Intel and Microsoft), is poised to make a significant dent in its profits. Steve Ballmer, Microsoft's second-in-command, acknowledges that unless personal computers are cheap enough to buy and maintain, a certain segment of the market (he estimates around 25% of current potential purchasers of personal computers) will buy network computers instead.

Ballmer divides the current buyers of personal computers into three definite market sectors: knowledge workers who need a powerful desktop computer, mobile workers who need efficient mobile communications (presumably currently addressed with a laptop computer), and production workers who need a computer which he calls a 'dumb terminal replacement'. This third sector is the one most vulnerable to the network computer, accounting for about 25% of personal computer sales.

The area most often touted as being the big market for network computers, on the other hand, in the home, is not even given credit by Ballmer as being of note. He cites that the cost of a Pentium computer next year will be around the same price as a network computer.

Meanwhile, other people are proposing that Microsoft is too complacent. Network computers will rely heavily on the Java language and it's Java which is seen by all (except, perhaps, notably Microsoft) as being important. Reports that Java could cut the costs of personal computing programs to 20% of their current levels are emerging. If that happens, Microsoft could be out on a limb, and the network computer on the main trunkline to success.

Money give-away

Domain Name supplier, Netbenefit, is offering a rebate to all its customers who registered a UK Domain with the company during the month of August 1996. NetBenefit is the first company to respond to the decision from Nominet, the Domain Names administrative body in the UK, to give an additional 50% rebate on the registration fees for all UK Domain Names registered with Nominet in August.

Nominet charges £100 for two years registration for non-members and £60 for members. As a founder member company, NetBenefit qualifies for this discount and, unlike some other members, already pass on the entire discount by charging £60 to its customers.

Contact: NetBenefit, Tel: (0171) 336 6777.

See page 70/71 for this month's destinations

PigMail

Macintosh Internet surfers might like to investigate a very cool e-mailing application designed for pen-friendships. It's particularly suitable for school use, where groups of students can use it as a database of worldwide pen-friends, although there's nothing to stop individuals using it too. Basically, each user has a directory of other users of PigMail worldwide. You find individual users by locating them on a world map and zooming into areas, countries, and habitats until you locate someone you'd like to get in touch with.

You can update your own database by downloading the latest update from the PigMail site, so that you can be kept up-to-date with new users and features. It's actually so good that, because it sits transparently on top of your Internet connection, you can in fact use it to manage all your e-mail, rather than using your old e-mail program. If you're lucky enough to have an Internet account with one of the many Internet service providers who provide multiple mailboxes, PigMail's best use would probably be to manage just one mailbox. That way, the kids (of whatever age) could use it alongside the main mailbox.

It's available for free download from **`http://www.cyberpuppy com/`**, and is a real treat to use.

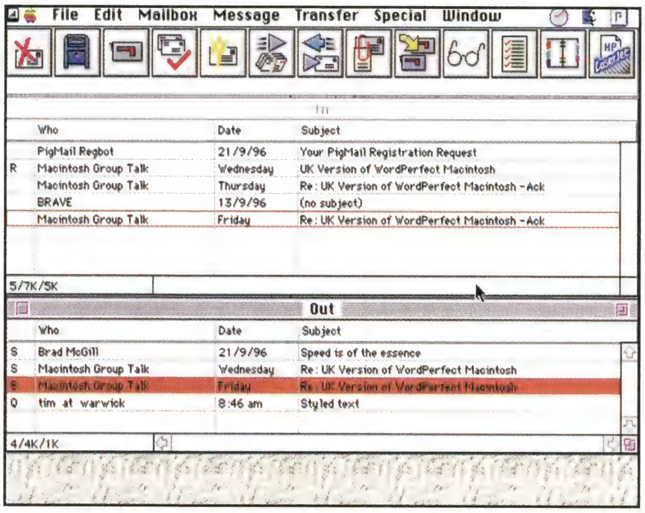
Better e-mail

The world's best e-mail program, Eudora, just got better with the release of version 3. While it does merit a full number increase from version 2 to version 3 because of its numerous new features, it's still the same basic old interface of mailboxes and filters to sort your mail, but it now includes a customisable toolbar which provides easy and quick access to your favourite functions.

Styled text to the text/enriched MIME standard is now supported, so you can stylise your e-mails now and receive stylised e-mails from other users of e-mail programs which support the standard. Styles supported in the standard include, bold, italic, underline, aligning, size (to one of five relative sizes), margin indenting, colour (black, red, green, blue, yellow, brown), and font.

If you insert a URL, or if you receive an e-mail with a URL in, it's automatically highlighted by Eudora, provided it's prefixed and suffixed in the now-standard way by less than (<) and greater than (>) signs. Double-clicking a URL opens an accompanying associated program such as a Web browser, ftp, gopher or finger program to do what you want.

Finally, the last of the new features worthy of note here are the new-found ability to drag-and-drop messages between mailboxes, and proper drag-and-drop text editing support. All-in-all, Eudora version 3 is a program you really must check out, if you haven't already.

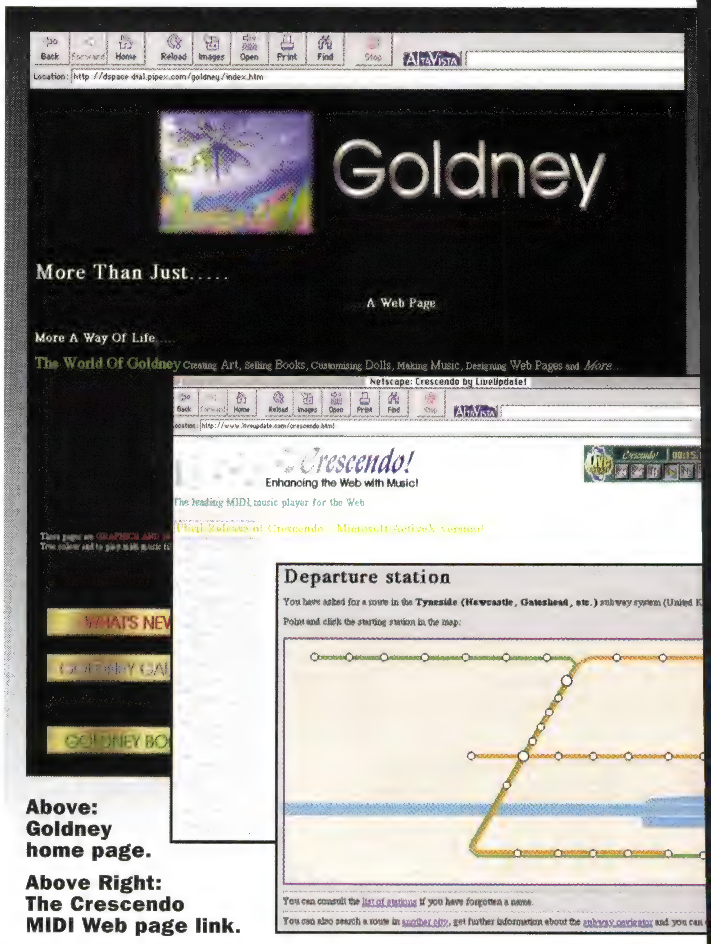


	Who	Date	Subject
	PigMail Regbot	21/9/96	Your PigMail Registration Request
R	Macintosh Group Talk	Wednesday	UK Version of WordPerfect Macintosh
	Macintosh Group Talk	Thursday	Re: UK Version of WordPerfect Macintosh -Ack
	BRAVE	13/9/96	(no subject)
	Macintosh Group Talk	Friday	Re: UK Version of WordPerfect Macintosh -Ack

5/7K/5K

	Who	Date	Subject
S	Brad McGill	21/9/96	Speed is of the essence
S	Macintosh Group Talk	Wednesday	Re: UK Version of WordPerfect Macintosh
S	Macintosh Group Talk	Friday	Re: UK Version of WordPerfect Macintosh
Q	tim at warwick	8:46 am	Styled text

4/4K/1K



Location: http://dspace.dial.pipex.com/goldney/index.htm

More Than Just.....

A Web Page

More A Way Of Life.....

The World Of Goldney Creating Art, Selling Books, Customising Dolls, Making Music, Designing Web Pages and *More*...

Location: http://www.liveupdate.com/crescendo.html

Crescendo!

Enhancing the Web with Music!

The leading MIDI music player for the Web

Final Release of Crescendo - Microsoft ActiveX version!

Departure station

You have asked for a route in the **Tyneside (Newcastle, Gateshead, etc.)** subway system (United K

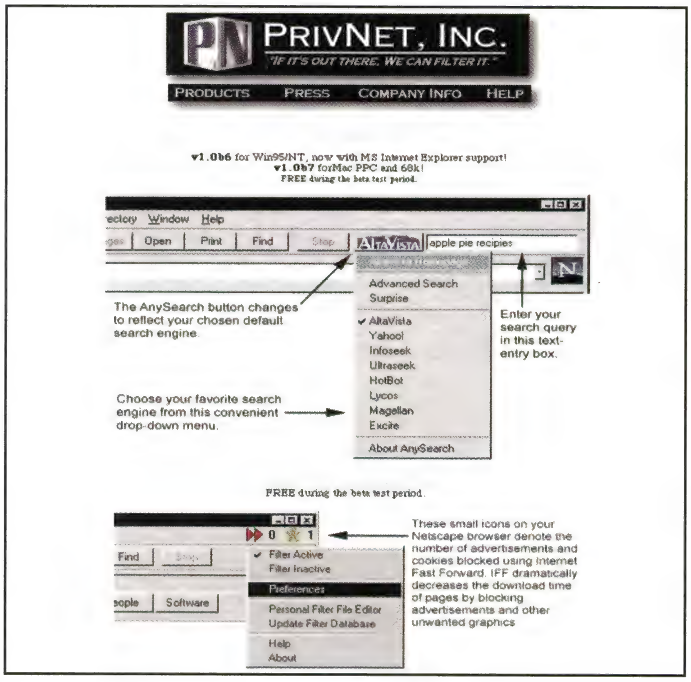
Point and click the starting station in the map:

You can consult the list of stations if you have forgotten a name.

You can also search a route in another city, get further information about the subway navigator and you can

Above: Goldney home page.

Above Right: The Crescendo MIDI Web page link.



v1.0b6 for Win95/NT, now with MS Internet Explorer support!
v1.0b7 forMac PPC and 68k!
FREE during the beta test period.

The AnySearch button changes to reflect your chosen default search engine.

Enter your search query in this text-entry box.

Choose your favorite search engine from this convenient drop-down menu.

FREE during the beta test period.

These small icons on your Netscape browser denote the number of advertisements and cookies blocked using Internet Fast Forward. IFF dramatically decreases the download time of pages by blocking advertisements and other unwanted graphics

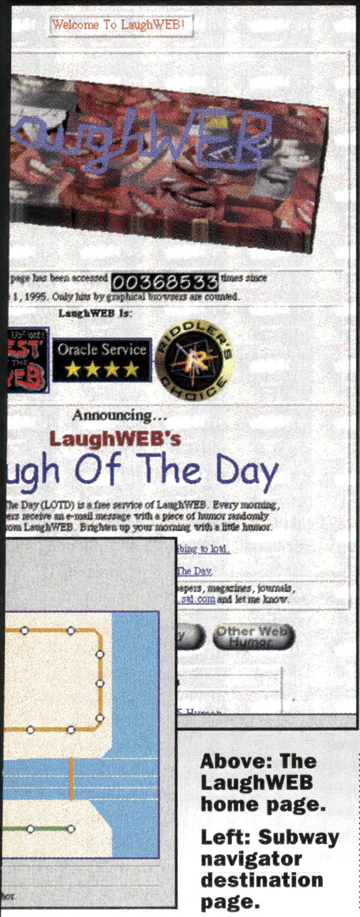
Accessing Search Engines

If you use your Web browser to access search engines on the World Wide Web, which from time-to-time most of us do, then AnySearch is of interest. AnySearch is a small add-on to Netscape Navigator which adds an extra button and text entry field so that you can instantly search your favourite search engine. Whatever text you enter into the field is used directly by the search engine, so it's easy to either type in what you want to search for, or copy and paste text from a page already displayed in the Web browser window.

AnySearch is in beta testing phase, and you can download a free copy (Mac or Windows) for installation in your Web browser from **`http://www.privnet.com`**. If you use search engines at all, AnySearch is a cool utility.

Site Survey

The month's destinations



page has been accessed 00368533 times since
1, 1995. Only hits by graphical browsers are counted.

Announcing...
LaughWEB's
ugh Of The Day

The Day (LOTD) is a free service of LaughWEB. Every morning,
ers receive an e-mail message with a piece of humor randomly
om LaughWEB. Brighten up your morning with a little humor.

Above: The LaughWEB home page.

Left: Subway navigator destination page.

The month's destinations If you travel the world, or even to your local city, maps of underground railway networks are a boon. Check out the subway navigator at **http://metro.jussieu.fr:10001/bin/cities/english**, where you'll be able to skip to station lists and maps from subway networks around the world, and create your personalised route to your travel destination.

Download Crescendo from **http://www.liveupdate.com/crescendo.html** and install it as a plug-in to your Web browser, and you can be listening to live MIDI created music over the Web. Crescendo allows MIDI musicians to link Web pages to MIDI files, and the plug-in lets Web browsers play the music. A cool site using Crescendo is: The Way of Goldney, at **http://dspace.dial.pipex.com/goldney/**, where you'll even find a musician who can create MIDI files directly for you.

Finally, for a giggle, go to LaughWEB at **http://world.std.com/~joeshmoe/laughweb/lweb_ns.html**. Here, you can find jokes galore. Did you hear the one about. . . .

ELECTRONICS and Beyond

next issue

Test Pattern Generator

Ideal for TV experimenters and repair engineers alike, this 'plug in and go' project enables the creation of a variety of patterns to be displayed on any domestic TV set.

On-Guard

Protect your valued possessions from the light-fingered brigade with this security project, which features an entry/exit delay and a loop cable which can be threaded through vulnerable contents within a room.

Educational Supplement

Another great assortment of entertaining and easy-to-make projects and essential electronics information aimed at the novice instructor.

PLUS Digital Audio Broadcasting by Ian Poole investigates the revolutionary technology set to transform radio listening into a CD-quality audio experience, with advanced station tuning for added user friendliness.

Eureca from Douglas Clarkson describes the EUropean REcoverable CArrier, a reusable scientific space platform, from which out-of-this-world experiments can be conducted.

The opening episode of a new 4-part series, Audio Delay-line Systems by Ray Marston, explains audio delay line principles.

Touch Key Technology by Tony Ellis continues to demonstrate applications for the new ultra-high security electronic key lock systems, with circuit examples.

Synchronous Network Architecture and Internetworks from Frank Booty guides us around the most popular protocol on Wide Area Network (WAN) technology.

What's in a Name? is a new series from Greg Grant, looking at how some of the more (and less) familiar names associated with the scientific world arose.

Part 3 of PIC Programming by Stephen Waddington focuses on some of the special features and I/O capabilities of the versatile PIC16C84 microcontroller.

Issue 109 on sale Friday 6th December

BRITAIN'S BEST MAGAZINE FOR ELECTRONICS

Project Ratings

Projects presented in this issue are rated on a 1 to 5 for ease or difficulty of construction to help you decide whether it is within your construction capabilities before you undertake the project. The ratings are as follows:

PROJECT RATING 1	Simple to build and understand and suitable for absolute beginners. Basic of tools required (e.g., soldering, side cutters, pliers, wire strippers, and screwdriver). Test gear not required and no setting-up needed.
PROJECT RATING 2	Easy to build, but not suitable for absolute beginners. Some test gear (e.g. multimeter) may be required, and may also need setting-up or testing.
PROJECT RATING 3	Average. Some skill in construction or more extensive setting-up required.
PROJECT RATING 4	Advanced. Fairly high level of skill in construction, specialised test gear or setting-up may be required.
PROJECT RATING 5	Complex. High level of skill in construction, specialised test gear may be required. Construction may involve complex wiring. Recommended for skilled constructors only.

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Internet

You can contact Maplin Electronics via e-mail at `<recipient>@maplin.co.uk` or visit the Maplin web site at `http://www.maplin.co.uk`.

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If you have a technical enquiry relating to Maplin projects, components and products featured in *Electronics and Beyond*, the Technical Sales Dept. may be able to help. You can obtain help in several ways; ❶ Over the phone, telephone (01702) 556001 between 9.00am and 5.30pm Monday to Friday, except public holidays; ❷ By sending a facsimile, Fax (01702) 554001; ❸ Or by writing to Technical Sales, Maplin Electronics PLC., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Don't forget to include a stamped self-addressed envelope if you want a written reply! Technical Sales are unable to answer enquires relating to third-party products or components which are not stocked by Maplin.

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If you get completely stuck with your project and you are unable to get it working, take advantage of the Maplin 'Get You Working' Service. This service is available for all Maplin kits and projects with the exception of: 'Data Files'; projects not built on Maplin ready etched PCBs; projects built with the majority of components not supplied by Maplin; Circuit Maker ideas; Mini-Circuits or other similar 'building block' and 'application' circuits. To take advantage of the service return the complete kit to: Returns Department, Maplin Electronics PLC., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Enclose a cheque or Postal Order for the servicing cost (minimum £17) as indicated in the current Maplin Catalogue. If the fault is due to any error on our part, the project will be repaired free of charge. If the fault is due to any error on your part, you will be charged the standard servicing cost, plus parts.

TECHNOLOGY WATCH

with Martin Pipe

This month, I will be reflecting on computing's interconnected past, and what many see as the future. In the first computing era, there were mainframes. These colossal, highly expensive and inspirational machines, with their seemingly-endless rows of tape and disk drives, in air-conditioned rooms served hundreds of users who would run time-shared programs on terminals located in the building, or in separate facilities via modems. Mainframes, the province of sizeable multinational corporations and governments, had their heyday in the 1960s and 1970s.

In the mid-1970s, minicomputers – typically serving tens of users – became popular, and the second era commenced. Their lower price brought computing within the reach of more companies. The larger organisations would often buy minicomputers for their smaller facilities, and network them to the mainframes. The age of distributed computing had begun. Microcomputers, or personal computers, came into their own in the 1980s – the third era of computing. All users could have control of an individual machine, upon which data and programs specific to their individual requirements could be kept. PCs were cheap enough for small businesses and even members of the public to own.

In the mid-80s, companies began connecting their PCs together to form local area networks, or LANs. Although they recognised the intrinsic values of personal computing, the possibility of sharing files and programs with members of the same department was seen as useful. A LAN could, via the appropriate software, hardware and communications channels, be attached to other LANs, minicomputers and mainframes throughout the organisation. A PC LAN offered all of the advantages of the previous-era minicomputers, but users still had degrees of independence. By this time, the PCs had fallen in price by so much as to make minicomputer-based alternatives appear expensive and outdated.

In the 1960s, the Internet began as a resilient network of data communication channels. Its initial purpose was ensuring that US military computers could remain in touch with each other, even if part of the network should be destroyed by a nuclear strike. In the three decades that followed, the Internet expanded to include educational facilities and other countries. Then it became available to businesses and the public, mostly through Internet service providers. This takes us to the present era of Internet computing. Connect your PC to the Internet, and it becomes another part of this vast global network.

Computer manufacturers saw the ways in which the Internet worked, and recognised that the communication over a LAN adhered to the Internet's packetised protocols. Now companies began connecting their networks to their Internet, using a 'firewall' to prevent unwelcome intruders from gaining unauthorised access to information deemed as confidential. Companies could now send and receive e-mail from customers, suppliers and other 'Internetted' departments, be they down the road or on the next customer.

The NHS has committed itself to just such a system, known as NHSnet – other public bodies could follow suit. Just about every new software release is Internet-enabled'; in other words, closely-integrated with the mechanics of Internet access, its applications and data. You could grab bits of Web page and stuff them in your own documents, initiate dial-up, create e-mails or save a file to a hard-disk located thousands of miles away.

The LAN is now evolving into the 'intranet'. These are effectively localised and independent mini-Internets' that can be run within an enterprise. The standard piece of software that is likely to be used is the good old Web browser – mainly because it is so easy to use, and modern versions support e-mail and user-specific plug-in' programs to support various types of data. Established LAN hardware – such as Windows PCs, Ethernet cards and file servers – are compatible, making Intranets relatively inexpensive to set up, particularly where modern LANs exist already.

Web-type documents, authored in HTML, would be used to disseminate information around the company. The Web's multimedia potential – pictures, text, sound and video – will allow business communication to be achieved in an unprecedented way. Each corporate Intranet-surfer would normally only be granted access rights, by an administrator, to the information deemed appropriate. This preserves security, but equally importantly prevents employees from burying themselves in information.

Existing computer software, such as we know it, could disappear. Instead of loading a word processor or spreadsheet program from Windows or MacOS, you would download it from the Intranet's file server as an efficiently-coded Java applet. Java is an object-oriented programming language (like C++), and programs written in it can be downloaded and executed under the Web browser; in other words, using the same user interface. Any recent browser will run Java applets, provided that the needed virtual-machine plug-in has been installed. Some specialist programs – such as CAD and DTP – will be too complex to be ported into Java, but the results (drawings and newsletters) could certainly be placed on the Intranet.

Special computers, known as network computers' or NCs, have been developed for Intranet use. A consortium, including IBM, Oracle, Netscape, Apple and JavaSoft (a division of Sun), have been thrashing out the specifications. They are cut-down PCs, likely to be based around RISC processors (from the likes of ARM, Hitachi, etc), and will sell for a low price (around $500). Apple and IBM, amongst others, have demonstrated prototype NCs. Since the user only needs to run downloadable Java applets, there's no need for local storage. The browser program will be stored on ROM, and appear at boot-up.

Some NCs will offer the facility to connect floppy and hard disks – some users will feel more comfortable holding oft-used applets and confidential files locally. The implications of NCs for network hardware is vast. Since programs and multimedia data are flying around, the 10M-bit/s rate offered by Ethernet may be insufficient for commercial applications where time equals money. The newer Fast Ethernet (100M-bit/s) may be more suitable. What's more, the central file server, and its enormous hard disks, need to be mega-fast. Careful management of the information stored there is essential, to avoid the duplication – or indeed accidental deletion – of information. The importance of the file server harks back, ironically, to the first era' of the mainframe!

The low price of NCs makes them ideal for domestic use. They won't be seen in the home, however, until the cable companies get their acts together and deliver the promised Ethernet-speed data channels – the 28.8k-bit/s (v.34 standard) currently available over a telephone line will be too slow for the frequent download of applets. Those cable data channels are several orders of magnitude faster, reducing waits to an acceptable level. They could link homes to a local server which caches often-accessed Web sites and newsgroups, as well as holding local information, and applets such as multi-user games, cable 'videotelephony' software and word-processors.

Consumer electronics manufacturers, such as Sony and Philips, will build them into TV sets. Sony has demonstrated a prototype – it was featured in the company's Live '96 extravaganza. Philips, meanwhile, already sells an networkable intelligent monitor as an interactive information display for use at airports, shops, etc. The Net in your set' could soon be with us – and with it the next computing era.

E-mail your comments or suggestions to Martin Pipe at `whatnet@cix.compulink.co.uk`.

Apple Pippin prototype.

ELECTRONICS and Beyond

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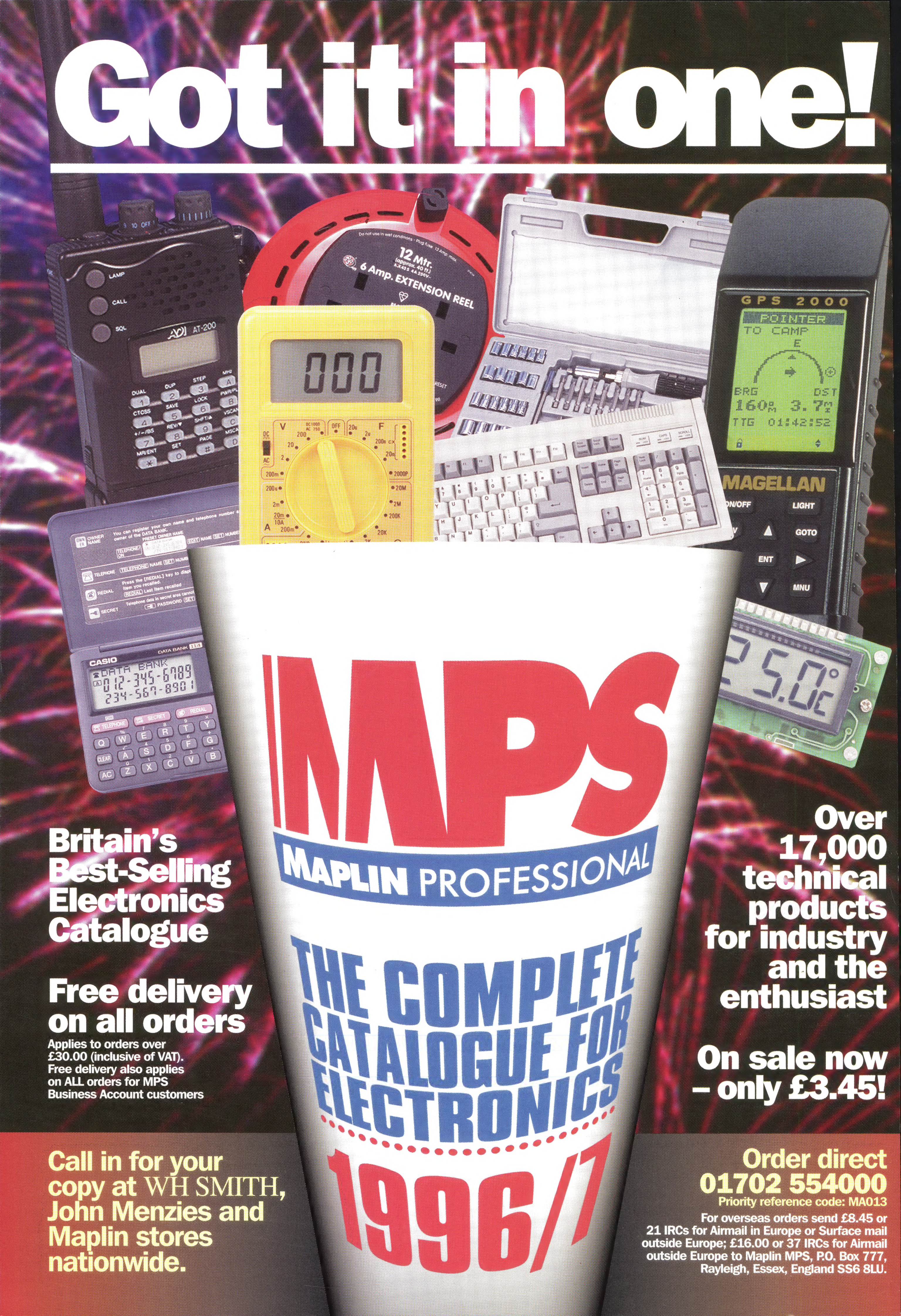

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